REPORT TO CONGRESS

on the activities of the

DoD Office of Technology Transition

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This report responds to 10 USC 2515

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(Laboratory Management and Technology Transition)

EXECUTIVE SUMMARY

The Office of Technology Transition (OTT) was created by the Secretary of Defense in response to 10 U.S.C. § 2515, to serve as a focal point for the domestic technology transfer activities of the Department of Defense. This report, required by legislation, summarizes OTT accomplishments for FY 98.

OTT has played an active role in development and/or execution of technology transfer programs; in development of technology/dual use technology policy; and in coordination of the collection and dissemination of scientific and technical information in support of technology transfer. Specific activities conducted in FY 98 are discussed in this report and its appendices. In summary, this office:

- Provided leadership and focus for the DoD Technology Transfer Program
  - Two studies were conducted in support of technology transfer activities: one assessed international participation in Cooperative Research and Development Agreements (CRADAs) and one assessed the value of CRADAs to DoD.
  - 13 DoD representatives served in elected and non-elected positions within the Federal Laboratory Consortium for Technology Transfer (FLC) organizational structure and DoD organizations provided $668,878 in financial support to the FLC. Additionally, ten teams of DoD scientists and engineers won FLC Annual Awards for Excellence in Technology Transfer which recognize laboratory employees who have done outstanding work in the process of transferring lab-developed technology to the private sector.
  - The TechTRANSIT website (http://www.dtic.mil/techtransit/) was upgraded with a new look and new information that offers easier access to partnering opportunities within DoD.

- Managed the DoD Dual Use Science and Technology Program
  - In the first two years, 164 projects have been initiated with a total value of over $550 million.

- Prepared a solicitation for the Small Business Innovation Research (SBIR) Program focused on technology transfer
  - 91 Phase I contracts were selected and funded at $9 million and 30 Phase II contracts were awarded and funded at $22 million.

- Provided oversight for the DoD Manufacturing Technology Program
  - A ManTech “Day on the Hill” was held in February 1998 to highlight technical accomplishments contributing to the Department’s goals for affordability, military/commercial integration, and improved weapon system performance.
  - The Navy’s Best Manufacturing Practices program was named a winner of the 1998 Innovations in American Government Awards.
  - The Defense Manufacturing Conference continues to be a premier activity for networking and sharing the results of ongoing and completed manufacturing and dual-use programs across the DoD, industry, and other government agencies. The 1998 conference had over 900 participants.

- Directed the collection and dissemination of technology transfer information by the Defense Technical Information Center (DTIC).
  - •• DTTIC maintains the Defense Technology Transfer Information System database with information on over 2,788 technology transfer actions.

- Coordinated the Independent Research and Development (IR&D) Program
  - •• In 1997, OSD completed an evaluation of the IR&D program focusing on the impact changes in regulations and policy had on the IR&D program. During 1998, the evaluation's results guided actions to further improve both program oversight and communications with industry.

- Provided direction and oversight for the Defense Production Act Title III Program
  - •• The Title III Program is unique among DoD programs since it is the only program specifically aimed at establishing or expanding domestic production capacity. During 1998, the Title III Program began development of 3 new projects in addition to continuing to execute six existing projects. The cumulative value of all active Title III projects exceeds $90 million.

- Provided direction and oversight for the Commercial Operations and Support Savings Initiative (COSSI)
  - •• Thirty projects were selected in the first round of COSSI project selection representing development and qualification costs of $96 million.

TABLE OF CONTENTS

I. BACKGROUND

Section 2515 of title 10, United States Code (Appendix A) - directs that "The Secretary of Defense shall establish within the Office of the Secretary of Defense an Office of Technology Transition." It further directs that the head of the office will ensure that the office will monitor research and development (R&D) activities of the Department of Defense; identify R&D activities that result in technological advances that have potential for nondefense commercial applications; serve as a clearinghouse for, coordinate, and actively facilitate the transfer of such technologies and technological advancements to the private sector; conduct its activities in consultation and coordination with the Department of Energy and the Department of Commerce; and provide private firms with assistance in resolving problems related to technology transfer. It also directs the Secretary of Defense to submit to the Committees on Armed Services, and Appropriations of the Senate and the House of Representatives an annual report on the activities of the Office at the same time the budget is submitted to Congress by the President. This report responds to that requirement and is the sixth annual report.

In 1995, the OTT was combined with the Laboratory Management oversight function within the Office of the Director for Defense Research and Engineering. The present Deputy Director for Defense Research and Engineering (Laboratory Management/ Technology Transition) is Dr. Lance A. Davis.

In FY 98, the Defense Technical Information Center was moved into the Defense Information Systems Agency for management, support, and overall guidance. However, as the repository of DoD S&T information, it continues to support technology transfer functions through maintenance of websites, databases, information analysis centers, and other sources of technical information. It is anticipated this support will continue to assist in monitoring R&D activities and facilitating the transfer of technology.

In keeping with the integrated planning and process team concept throughout the Department, the activities of the Office are conducted with the consultation and support of personnel in the Military Departments and Defense Agencies.

II. INTRODUCTION

The Congress required establishment of the Office of Technology Transition with, we believe, the underlying assumption that the Defense Laboratories and Defense Agencies are technological powerhouses whose efforts can be brought to bear on domestic commercial technology opportunities at one and the same time that defense critical needs are being addressed. The technological investments made by the DoD to develop agile, smart weapons systems, training systems, trauma care, etc, have caused, in many cases, an economic impact far larger than that suggested by the program budgets alone, therefore enhancing the nation's industrial competitiveness or otherwise improving the Nation's quality of life.

DoD is working to develop a broad Technology Transfer Program which encompasses the Department as a whole. We are trying to use a common sense approach to this program to break down barriers preventing us from commercializing appropriate technology. We are also trying to expand our horizons to use what is readily available from the commercial sector. Two programs were transferred from the Deputy Under Secretary of Defense for Industrial and Commercial Programs to this office in FY 98 to strengthen the Technology Transfer Program. These two commercially-oriented programs are the Defense Production Act Title III program and Commercial Operations and Support Savings Initiative. By leveraging available resources, we can expand and enhance our capabilities both within our weapons systems and within our processes for making the transfer of technology possible. In doing so, it is recognized that the Nation will achieve an improved return on its national security technology investment and the Nation's industrial competitiveness will be improved. In every case, however, the essential goal is to achieve technically superior, affordable defense systems; those technology efforts which contribute to international competitiveness, but have no defense relevance, are the proper province of other Federal agencies and/or private industry.

The DoD Technology Transfer Program is a dynamic program which we anticipate will contribute to more affordable defense systems in the future.

III. OFFICE OF TECHNOLOGY TRANSITION ACTIVITIES

- Defense Technology Transfer Management & Oversight
- Dual Use Science and Technology Program
- Small Business Innovation Research
- Manufacturing Technology Program
- Defense Technical Information Center
- Independent Research and Development
- Commercial Operations and Support Savings Initiative
- Title III of the Defense Production Act

A. DEFENSE TECHNOLOGY TRANSFER MANAGEMENT AND OVERSIGHT

The Defense Department operates a decentralized technology transfer program. The Military Departments are recognized as separate agencies for program implementation. There are over 100 Offices of Research and Technology Applications (ORTAs) and other technology transfer focal points. Additionally, we have about half that many legal staffs throughout DoD supporting technology transfer functions.

Communication is necessary within and between Defense Department technology transfer activities as well as with potential and existing partners in the private sector. The Defense Technology Transfer Working Group (DTTWG) is a key element in communication within the DoD. Other tools being used are the Federal Laboratory Consortium for Technology Transfer (FLC), DoD Workshops such as the Technology Transfer Integrated Planning Team, websites such as TechTRANSIT, policy such as a draft DoD Directive and Instruction on Technology Transfer, and other meetings and activities. Two special studies were conducted this year, one to assess foreign participation in CRADAs and one to assess the value of Cooperative R&D Agreements to DoD.

Defense Technology Transfer Working Group (DTTWG)

The DTTWG was established in 1994 and is composed of representatives from each of the Military Departments and most of the Defense Agencies. This group meets monthly to review technology transfer issues requiring either consistent policy or approach from a joint Department of Defense perspective. Issues for FY 98 included:

- international participation in CRADAs;
- topics for the DoD TTIPT workshop;
- unplanned funding for DoD technology transfer activities (MSU TechLink and Commercialization of Technology to Lower Defense Costs);
- legislative proposals (HR 2544 and S2120); and
- FLC participation from DoD

DoD Technology Transfer Policy

The DTTWG and Military Department intellectual property attorneys developed a draft DoD Directive on domestic technology transfer in FY 97. This Directive is being coordinated within the Department. This Directive will institutionalize policy on domestic technology transfer and stress the importance of technology transfer as a key activity within DoD. When the Directive is signed, an Instruction will be issued identifying specific procedures for technology transfer implementation and a Handbook identifying best practices and various ways of doing technology transfer will be issued.

Federal Laboratory Consortium for Technology Transfer

The Military Departments and Defense Agencies have been participating in the Federal Laboratory Consortium for Technology Transfer (FLC) through financial support (see Table 1) and participation in meetings by their technology transfer focal points. The FLC provides an opportunity to share information with other federal agency technology transfer professionals and learn about methods employed in other agencies that could help DoD. The FLC also provides a forum for joint work efforts and consolidation of activities. The FY 98 FLC National Meeting, held

in the spring, provided an opportunity for DoD to hold its fourth joint session bringing the Military Departments and Defense Agency representatives together for an information sharing session. These sessions have proven to be beneficial and, therefore, future FLC meetings will continue to include joint DoD sessions.

FY 98 DoD Support to FLC

Navy	$246,080.00
Army	$160,608.00
Air Force	$102,512.00
DoD HQ	$47,440.00
BMDO	$45,872.00
DARPA	$32,576.00
DoD Test & Evaluation	$19,728.00
Defense Special Weapons Agency	$5,104.00
US Special Operational	$3,232.00
Operational Test & Evaluation	$1,880.00
Defense Information Systems	$1,872.00
Defense Logistics Agency	$1,088.00
NIMA	$832.00
Joint Chiefs	$54.00
Total	**$668,878.00**

Source: Federal Laboratory Consortium for Technology Transfer

FLC Award Winners

The FLC Annual Awards for Excellence in Technology Transfer recognize laboratory employees who have done outstanding work in the process of transferring lab-developed technology. Nominations are made by laboratory representatives and are judged by a panel of experts in the field of technology transfer. The 1998 Department of Defense winners are:

- **John P. Mistretta** of **Air Force** Wright Laboratory, for the incorporation of advanced composite materials to cost-effectively rehabilitate bridges;
- **Vincent F. Hock**, **Susan A. Drozdz**, **Curt Gustafson**, and **Bob Bruton** of **Army** Construction Engineering Research Laboratory (CERL), for the development and transfer of in-situ chemical stabilization of lead-based waste from abrasive blasting;
- **Richard G. Lampo**, **Thomas J. Nosker**, **Alan E. Robbins**, and **Malcolm G. McLaren, Jr.**, of **Army** Construction Engineering Research Laboratory (CERL), for the development and transfer of plastic lumber materials for construction;
- **Jeffery P. Holland**, **David R. Richards**, **Cary A. Talbot**, and **Earl V. Edris** of **Army** Engineer Waterways Experiment Station, for the development and transfer of the Department of Defense's groundwater modeling system;
- **Jeffrey A. Melby** and **George F. Turk** of **Army** Engineer Waterways Experiment Station, for the development of a new and improved concrete armor unit for breakwaters;
- **Robert L. Trottier** and **Peter G. Lavigne** of **Army** Natick Research, Development, and Engineering Center, for the transfer of military self-heating technology for retail use;
- **Jeff Horey**, **Bob McCormack**, **Ron Wolff**, and **Edward Purvis** of **Naval** Air Warfare Center's Training Systems Division, for development and transfer

of the Weapons Team Engagement Trainer that simulates hostage rescue, room clearing, and terrorist encounters;

- **Michael D. Seltzer** and **Gerhard A. Meyer** of **Naval** Air Warfare Center's Weapons Division, China Lake, for development and transfer of the Thermo Jarrell Ash TraceAIR, a monitoring system for toxic airborne metals;
- **Peter McGraw**, **Charles Kelly**, **Carlton Jones, Jr.**, **Dwight Lavinder**, **Thomas Walters**, **DietrichWiegman**, **Craig Alig**, and **Reid McAllister** of **Naval** Surface Warfare Center's Carderock Division, for development of the Plastics Waste Processor;
- **Norman L. Owsley** and **Andrew J. Hull** of **Naval** Undersea Warfare Center, for the development of the noninvasive identification of acoustic signals generated during the human cardiac cycle.

In addition, the 1998 FLC Representative of the Year Award was presented to **Margaret M. (Peg) McNamara**, **Naval** Underwater Warfare Center, for her work in the area of Technology Transfer and support to the FLC.

DoD Representatives to the FLC

DoD representatives serve in both elected and nonelected positions with the FLC. These leadership functions facilitate sharing of information with other federal departments and agencies and contribute to specific technology transfer activities. The following DoD personnel hold positions in the FLC.

FLC Position	Name/Organization
FLC Vice Chair and Chair, Planning and Policy Committee	Douglas Blair/Air Force Research Lab
Chair, Financial Management Committee	Karen Gordon/Army Night Vision Lab
Chair, Awards Committee	Sue Ibrahim/Army Yuma Proving Ground
Co-chair, Legal Issues Committee	David Spevack/Navy Medical Research Center
Co-chair, Legal Issues Committee	Charles Harris/Army Medical Research & Materiel Command
Chair, Education Committee	Linda Jenkins/Naval Research Laboratory, Stennis Space Center
Co-chair, Program Committee SouthEast Regional Coordinator	Ed Linsenmeyer/Naval Surface Warfare Center, Coastal Systems Station
Co-chair, Program Committee	Norma Cammarrata/Army Research Lab
Chair, Training Committee Co-chair, Mid-Atlantic Region	John Griffin/Army Topographic Engineering Center
Chair, Information Systems Committee Co-chair, Mid-Atlantic Region	Mike Rausa/Army Research Lab (Aberdeen)
Co-chair, Mid-Atlantic Region	Richard Dimmick/Army Research Lab (Aberdeen)
Chair, Far West Region	Michael Sullivan/Naval Air Warfare Center, Weapons Division Point Mugu
Member-At-Large	Katherine Drew/Office of Naval Research

DoD Technology Transfer Integrated Product Team (TTIPT) Workshop

The third DoD TTIPT Workshop was hosted by the Navy in Sandestin, Florida, in the fall of 1998. These workshops are important in improving the DoD technology transfer program because they allow sharing of best practices/lessons learned, provide opportunities for training, and enhance communication among the ORTAs and focal points. Over 90 technology transfer professionals attended this workshop.

The workshop provided an opportunity for seven tutorials, two training sessions, and Committee meetings on various issues of interest to technology transfer professionals. The tutorials included: laboratory management issues (i.e., FY 98 Defense Authorization Act requirements in Section 912), public-private partnerships and use of 10 USC 2667, marketing DoD developed technologies to the private sector (how do we let small businesses know technologies are available for their use?), National Interagency R&D Program for combating terrorism through rapid R&D and prototyping, Commercialization of Technologies to Lower Defense Costs Initiative (how it will work and how to participate in it) patent portfolio analysis and licensing using the National Technology Transfer Center's TOP Index, use and value of HBCU/MI program in technology transfer. The two training sessions were on Other Transaction Authority and Naval Research Laboratory patent licensing processes.

Websites

During FY 98 the Deputy Director, Defense Research and Engineering, Technology Transfer Office, upgraded its TechTRANSIT website (http://www.dtic.mil/techtransit/) with a new look that offers easier access to partnering opportunities within DoD. TechTRANSIT is the "gateway" for private industry and academia doing business with DoD laboratories. There are six sections of this website: Business Opportunities, News-Comments-Subscribe, Accomplishments, Meeting Room, Reference Room, and About TTO. Information about the Technology Transfer Office Charter, its programs, mission and goals can be found in "About TTO." In addition to an overview of technology transfer in DoD, it provides links to labs where technology transfer and business opportunities are available. The "Reference Room" provides information on DoD technology transfer policies, laws, and publications. "Business Opportunities" offers links to technology partnership opportunities such as licensing, cooperative R & D, facility sharing, technologies available for commercialization and other resources such as venture capital. The "Meeting Room" hosts a calendar where upcoming meetings of interest may be posted. "Accomplishments" showcases various highlights and achievements of the Technology Transfer Office and defense labs in the area of technology transfer. Monthly updates will feature success stories, awards and upcoming technology transfer meetings of interest.

Defense Technology Transfer Information System (DTTIS)

The DTTIS is maintained by the Defense Technical Information Center (DTIC) in cooperation with the Military Services and Defense Agencies. As of December 31, 1998, the DTTIS contained project information on 2,788 Technology Transfer Activities, including 1,363 active Cooperative Research and Development Agreements (CRADAs) and 143 active Patent License Agreements. Over 100 Technology Transfer professionals are registered to use the DTTIS password protected World Wide Web site to view and analyze technology transfer data. In 1998 input into the DTTIS included 551 new records and 1,597 record modifications. We believe DTTIS will help DoD ORTAs identify potential partnering opportunities with other DoD activities as well as identify joint development with the private sector which could be used to support other efforts within DoD.

Commercialization of Technologies to Lower Defense Costs Initiative

The Congress provided $5M in the Army's Environmental Quality Technology budget line for a program called Commercialization of Technologies to Lower Defense Costs

Initiative. The objective of this program is to lower U.S. defense procurement costs by promoting the commercialization of federal laboratory technologies. The Industrial Ecology Center at Picatinny Arsenal is managing this Initiative. The laboratory technology transfer professionals were briefed on this program at the 1998 TTIPT Workshop because one of the goals of this program is to commercialize the technologies developed at DoD laboratories which can assist in resolving environmental quality concerns. DOD technology transfer professionals can suggest technologies for further review/funding under this Initiative. Six candidate technologies have been selected and others are being submitted for review.

Interagency Working Group on Technology Transfer

The Department of Commerce chairs the Interagency Working Group on Technology Transfer (IAWG). The IAWG meets monthly with representatives of the Federal Departments to discuss technology transfer issues, policy, and proposed legislation. The Defense Department has been participating in the IAWG with representatives from the 3 Military Departments and the Office of the Secretary of Defense.

Montana TechLink

Both the FY 98 and FY 99 Defense Appropriation Acts provided $1M to establish and operate a rural defense technology transfer center called TechLink at the University of Montana at Bozeman. A statement of work is in the process of being finalized which should provide a link for regional businesses and industries with the technology and know-how available from the Defense Department. It is anticipated that TechLink will be a strong asset in developing the "pull" needed to commercialize defense technologies.

Special Studies

International Participation in CRADAs

A study, "International Participation in CRADAs," was commissioned to conduct a review of existing Cooperative Research and Development Agreements (CRADAs) with foreign participation to analyze the processes utilized by U.S. Government agencies in determining whether to include foreign partners in CRADAs. The study also proposed criteria and procedural options for agencies to consider when evaluating potential foreign involvement in CRADAs.

The analysis was conducted through extensive interviews with technology transfer practitioners and policymakers at various Federal agencies [such as Department of Energy (DOE), Department of Defense (DoD), National Institute of Health (NIH), Department of Commerce (DOC)], as well as other study teams, involved in evaluating foreign participation in CRADAs. In addition, existing research (e.g., case studies, cost share programs, academic literature) was reviewed and analyzed to understand how U.S. Government (USG) agencies protect the public interest when foreign entities participate in USG-sponsored research and development (R&D) collaborations. This activity was not intended to be comprehensive but only to illustrate how various organizations interpret provisions that deal with national security and economic security interests in public-private technology transfer partnerships.

The study was also used to respond to a request by the Director of the Office of Science and Technology Policy (OSTP) to review policies and procedures used by federal agencies to review major proposed CRADAs that involve critical national security technology or may have a significant impact on domestic or international competitiveness.

DoD Cooperative R&D Agreements: Value Added to the Mission

During FY 98 the office also undertook a study, "DoD Cooperative R&D Agreements: Value Added to the Mission," to evaluate a sampling of DoD CRADAs to assess the benefits to DoD. Legislation has focused on the transfer of technology from the federal laboratories to the private sector and the benefits to the industrial partner; however, we believe value has also been realized by the federal partners involved in CRADAs. We anticipate the results of this study will be available in February 1999.

Service / Agency Highlights

The decentralized approach to managing the technology transfer program in DoD enables each activity to accomplish what best meets their mission requirements. Some highlights of these activities which also benefit the commercial sector, broken out by Military Department, are in Appendix C.

Future Goals

All three Military Departments have similar goals in technology transfer outlined for FY 99. These goals include: 1) continue to develop and conduct training in technology transfer for ORTAs, legal staff, S&Es, and R&D managers; 2) expand marketing and outreach efforts to update and expand laboratory homepages to include technology transfer opportunities; and 3) continue to expand efforts to identify available technologies with commercial potential.

B. DUAL USE SCIENCE AND TECHNOLOGY PROGRAM

The ability of the United States to retain technological superiority on future battlefields will, in many cases, depend on the Nation's ability to take advantage of technological advances occurring in commercial industry. Commercial technology developments in such areas as electronics, advanced computing, communications, and medical research, are racing forward. These commercial developments are funded at levels that vastly exceed what the Department is currently able to apply. Greater reliance on commercial technologies not only will provide the Defense Department access to advances in technologies occurring in the commercial sector but also will allow the Department to take advantage of the competitive pressures and market-driven efficiencies inherent in the commercial sector. This competitive, market-driven approach will increase the pace at which technological improvements are incorporated into defense systems, while, at the same time, reducing the costs of those systems.

The Department of Defense's Dual Use Science and Technology (DU S&T) Program is designed to help the Department incorporate commercial technologies into defense systems. The Program was established in the Fiscal Year 1998 Defense Authorization Act. It has two primary goals. The first is to jointly fund and develop dual use technologies with industry. To support this goal, the Act provides for 50/50 government/industry cost share of development. Other incentives for industry to work with DoD's DU S&T Program, besides the 50 percent project cost share by the government, include: access to technology from the government and increased market opportunities with the Military Services. In addition to these business incentives, the Department is making it easier for commercial companies to enter into agreements with the DoD by using procedures that are not subject to most of the Federal procurement laws and regulations. These procedures, known as "Other Transactions" or "Cooperative Agreements," offer a great deal more flexibility and fewer regulatory requirements than do standard government contracting. The use of alternative procedures has provided the Department the ability to attract many commercial firms that would not otherwise do business with the DoD. The second goal is to make the development of dual use technologies with industry a normal way of doing business in the Services. The FY 98 Authorization Act has established goals for the initiation of dual use projects. These goals started at 5% of each Department's applied research program in FY 98 and will grow to 15% by 2001. The Military Services are actively working to meet these goals through the DU S&T Program and, in fact, have met the FY 98 goal.

In the first two years of the program, 164 projects have been initiated with a total value of over $550 million dollars including DU S&T funds, Military Department S&T funds, and industry cost sharing funds. In addition to the growing size of investments, it is encouraging to see the number of commercial firms that have become involved in the Program.

Military Department participation in the DU S&T Program has been key to the Program's success. The execution of the Program is currently transitioning from OSD to the Services. A third solicitation for proposals was issued for FY 99 in August 1998 and closed on December 15, 1998. Unlike for the first two years, this was a joint solicitation issued by the Navy and was used as a vehicle to launch an extensive outreach effort to industry. The culmination of this effort was two DU S&T Investment Strategy Conferences held in October 1998. The first was held in the Washington DC area and had 310 participants. The second was held in Los Angeles and had 229 participants.

As a result of this solicitation the Military Departments have received 178 proposals from industry that address Service requirements in the following focus Areas:

- Affordable Sensor Technology
- Aircraft Sustainment
- Distributed Mission Training
- Fuel Efficiency & Advanced Propulsion Technology
- Information Systems & Technology
- Medical Technologies
- High Speed Vessels & Structural Systems for Large Sea-Based Structures
- Environmental Monitoring

These proposals are currently being evaluated by the Military Departments and selections are expected by the end of February 1999.

As a result of the success experienced with the joint FY 99 solicitation, a joint solicitation for FY 00 will be issued, again by the Navy. To improve the timing of the program, the solicitation will be issued in January 1999 versus August. A conference in support of this solicitation is scheduled for the end of March 1999 and proposals will be due in April.

The DU S&T Program will submit a report to Congress this March. The report will include a complete description of the program and a summary of the FY 98 projects.

Examples of Current Projects:

Active Braking System for Medium Duty Wheeled Vehicles

This FY 97 project was initiated to develop and demonstrate a commercial active braking system and low speed traction control system for the Army's HMMWV and medium size commercial trucks. The company has received its first commercial order and it is planned to demonstrate the system on the HMMWV in February 1999.

Commercial Radiation -Tolerant Submicron Microelectronics

This is an FY 98 project that will modify an existing commercial fabrication facility to make it capable of manufacturing both conventional and radiation-tolerant electronic components off the same production facility. The radiation-tolerant electronic components produced on this line will be used for both the growing commercial satellite markets as well as in military space systems. The economies of scale will result in a significant cost saving over current radiation-tolerant electronics.

Wideband Airborne Antenna Development

This is also an FY 98 project that is developing a low cost phased array antenna that will work for the Low Earth Orbit commercial satellite industry while also meeting military requirements. Two orders of magnitude reduction in cost are expected due to the economies of scales.

Next Generation Transparency

This is an FY 97 project that is demonstrating the use of injection molding to make frameless transparencies (canopies) for advanced strike aircraft. The one-piece design will improve safety and dramatically reduce manufacturing and life cycle costs of canopies. Commercial applications include automobiles and aircraft.

C. SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

The SBIR program operates by setting aside 2.5% of extramural Research, Development, Test and Evaluation (RDT&E) funds to support dual use R&D activities by small businesses (less than 500 employees). In order to emphasize the importance of the OTT technology transfer mission and to encourage the defense labs to play an active role, the OSD SBIR program funds technology transfer topics in the OSD section of the DoD SBIR solicitation. The OSD SBIR program has commercialization of dual use technology as a primary goal; therefore, projects are primarily later stage, applied research, which appear to offer the greatest possibility for near-term technology transfer "spin on" or "spin off" commercialization.

Candidate technology areas were developed and topics were solicited from Army, Navy and Air Force labs. The OTT staff then selected the most promising of the topics, based upon commercialization potential. The OSD Office of Small and Disadvantaged Business Utilization (SADBU) issued two DoD-wide SBIR solicitations, one in January and the other in August 1998. There were 24 OSD topics in the first and 20 OSD topics in the second solicitation. This year, 91 Phase I contracts were selected and funded at $9 million. A total of 30 Phase II contracts were awarded and funded at $22 million. Approximately $17 million will fund OTT SBIR contracts in FY 99.

FY 98 SBIR topic descriptions can be found in Appendix D.

D. MANUFACTURING TECHNOLOGY (ManTech)

The ManTech Program is an important element in the Defense Department's actions to affordably acquire and sustain equipment for the warfighter. Emphasis is on maturing defense-essential manufacturing technologies to foster the rapid, low-risk transition of advanced technology into new systems and to extend the useful life of existing military systems. Investments made by the Military Departments and the Defense Logistics Agency (DLA) are grouped into two broad technology areas - Processing and Fabrication (P&F) and Advanced Manufacturing Enterprise (AME). P&F projects develop affordable, robust manufacturing processes for metals, composites, electronics, and specialty materials critical to defense applications over their full life cycle. AME projects encompass the entire chain of people, tools, and activities that develop, produce, and maintain a weapon system --- a chain that links commercial companies, defense contractors, maintenance depots, and military customers.

The appropriated funding level for Military Departments and Defense Logistics Agency (DLA) ManTech programs in FY 98 and FY 99 was $145 million and $185 million, respectively. The budget request for FY 00 is $134 million. A 5-year ManTech plan is being submitted to the Authorization Committees concurrent with the FY 00 President's Budget request.

Technology Transfer & Dual Use

The ManTech program is driven by defense needs for technologies and systems that provide a superior edge to the warfighters. In today's environment, DoD is involving the commercial industrial base as soon as possible, by either adopting its best practices or transferring results of military processes to the commercial arena. For example:

• The Navy's Best Manufacturing Practices (BMP) program, part of Navy ManTech, was named a winner of the 1998 Innovations in American Government awards. Recognized as one of the most prestigious public-service awards in the country, the Innovations award is sponsored by the Ford Foundation, and administered by Harvard University's John F. Kennedy School of Government in partnership with the Council for Excellence in Government. The award recognizes programs and policies that represent original and effective government initiatives at the federal, state, and local levels. For over ten years, the BMP survey process has been an avenue for industry (commercial and defense) and government to present individual and distinctive success stories in manufacturing disciplines by conducting on-site surveys for companies that are interested in sharing nonproprietary information.

• As a part of a Cooperative Agreement with the Air Force Research Laboratory, Silicon Integration Initiative, Inc., recently released the Electronic Component Information Exchange representation format. The information format and associated tools permits the exchange of electronic component information for system designers and engineers to make informed decisions on component selection early in the development process. This facilitates component selection via information available on the Internet and the feeding of engineering design tools with electronic data needed for detailed design and manufacturing. The format and commercial tool offerings have been demonstrated recently to leading electronic system developers and received positive comments and interest.

Recent Management Initiatives & Accomplishments

The S&T Affordability Task Force continues to establish processes to strengthen the affordability content of the DoD's S&T programs. The objective is to identify mechanisms that focus DoD's technology programs on implementing Integrated Product and Process Development (IPPD) and facilitate use of Integrated Product Teams. In 1998, the Task Force sponsored a conference attended by over 250 S&T managers and industry to share affordability best practices and lessons learned; reviewed and evaluated selected S&T programs for attention to affordability; and developed an awareness course to help S&T managers on affordability concepts. 1999 activities will focus on improving the process for transitioning the results of 6.3 advanced technology development efforts into acquisition, and publishing a handbook for S&T managers to use during formulation of affordability programs.

The Defense Manufacturing Conference (DMC) continues to be a premier activity for networking and sharing the results of ongoing and completed manufacturing and dual-use programs across the DoD, industry, and other government agencies. The 1998 conference was held in New Orleans, LA. Over 900 leaders from government, industry, and academia attended. Keynote speakers included Dr. Lance Davis, ODDR&E; MG John Caldwell, Army Materiel Command; Marc Morial, Mayor of New Orleans; Stan Soloway, Acquisition Reform; and Thomas Rabaut, United Defense Limited Partnership. The conference featured a customer perspective from both the Authorization staffers and the Program Managers for Joint Strike Fighter, Comanche, Crusader, and F-22. Exchange of technical information was promoted by use of concurrent briefings spanning over 100 technical projects, and via evening receptions held with over 50 exhibitors from DoD, industry, and academia.

To improve Congressional awareness of the program, a ManTech "Day on the Hill" was held in February 1998 to coincide with USD(A&T) testimony to the House National Security Committee Military Procurement and Research and Development Subcommittees. ODDR&E worked with the Military Departments, DLA, and industry associations to set up ManTech displays in the foyer of the Rayburn Office Building. Displays and poster sessions highlighted ManTech technical accomplishments that are contributing to the Department's goals for affordability, military/commercial integration, and improved weapon system performance.

Recommendations for Program Improvements

Section 2525 of Title 10 directs cost sharing on all ManTech projects. Section 213 of the Strom Thurmond Defense Authorization Act for FY 99 revised this requirement. Difficulties are still being experienced with this requirement, and we plan to submit a legislative proposal to resolve these problems.

E. DEFENSE TECHNICAL INFORMATION CENTER (DTIC)

Any technology transfer effort starts with the sharing of information, whether for transfer of technology into or out of the DoD or, indeed, for transfer between and among various DoD organizations. DTIC provides the function of sound information collection and dissemination capability for the DoD S&T community. Highlights of DTIC activities in FY 98 are presented below.

Defense Technology Transfer Information System (DTTIS)

DTIC maintains the DTTIS in cooperation with the Military Departments and Defense Agencies. As of December 31, 1998, the DTTIS contained project information on 2,788 DoD Technology Transfer Activities, including 1,363 active Cooperative Research and Development Agreements (CRADAs) and 143 active Patent License Agreements. Over 100 Technology Transfer professionals are registered to use the DTTIS password protected World Wide Web site to view and analyze technology transfer data. 1998 input into the DTTIS included 551 new records and 1,597 record modifications.

Independent Research and Development (IR&D or IRAD) Database

DTIC maintains a database with project description and financial information reflecting Independent Research and Development efforts conducted by Defense contractor activities. In 1998, the database received 4,109 project descriptions reflecting 2.5 billion dollars in 1998 IR&D investment. It is estimated that this reflects almost 90% of the cost recoverable IR&D efforts performed by defense contractors. The information in the database is proprietary and disseminated to U.S government activities only via an on- line subscription and CD-ROM. In 1998, DTIC worked with contributing contractors and the IR&D Technical Coordination Group to approve a secure IR&D World Wide Web site to better serve DoD customers in leveraging IR&D technology for DoD purposes.

Internet/World Wide Web (WWW)

The DoD has continued its leadership position within the Federal sector through the use of leading-edge technology to support information transfer via the Internet. Information technology improvements have increased the capabilities of the wide variety of products developed to deliver information to the public as well as those which support management of internal Department programs and functions. The enhancements in information transfer technologies have increased the public's awareness of overall Defense technological developments and have improved the transfer of information concerning these developments. The DTIC has developed and manages over 80 Web information systems used by the Office of the Secretary of Defense and its components to provide information to both internal and external users. The Government Information Locator System (GILS) is fully integrated into DoD Web services and provides indices, pointers, and searching capabilities to improve access to information about DoD technology assets.

Among the Web-based products available to the Defense community is the Science & Technology (S&T) Infoweb, which provides DoD S&T managers a single Web site which integrates the most current and authoritative data used for planning, decision making, and retrospective analysis. Budget data, S&T planning data, laboratory management data, and personnel data from multiple heterogeneous sources are validated and standardized to ensure accuracy and compatibility, and then are merged in a virtual database. This database, and its accompanying analysis tools, forms a single Web entity to

collect, store, disseminate, and analyze S&T management information. Value is added to the data through the wide range of options available to managers for both standard and custom reports which provide not only current "snapshots" of specific S&T activities, but trend indications across multiple years. The S&T InfoWeb is restricted to ".mil" users and is used by the entire Defense S&T community.

Registration for Access to DoD Technical Information

DTIC operates a registration system for access to Defense technical information. Through the registration system, DoD organizations and DoD contractors and potential contractors can access the DTIC databases to ascertain ongoing and completed R&D relevant to their work and interests. This facilitates and increases awareness of technology that is relevant to both Defense and commercial applications. Of the 4,662 organizational registrations active in FY 98, 1,998 were associated with private sector organizations. In addition, during the period that the DoD SBIR solicitations are active, DTIC registered an additional 800 small businesses to assist them in participating in this major Defense acquisition program.

DoD Technical Reports

DTIC is the central DoD repository for the collection and secondary dissemination of DoD technical reports. The reports are abstracted, indexed, and cataloged, as part of DTIC's on-line searchable database. During FY 98, the non-Government sector of the Defense industry conducted over 40,998 searches of DTIC databases and they received 307,298 output products from DTIC.

In addition, DoD pursues a policy of public release of Defense scientific and technical information whenever possible. This information is centrally collected, announced, and released for public purchase through the National Technical Information Service (NTIS) as part of their statutory mandate to supply Federal R&D information to the general public from the Federal Agencies. In FY 98, 21,249 technical reports were provided by DTIC to NTIS for public release and purchase. DoD provides over 30 percent of the annual submissions to NTIS that document the results of both in-house and Government contract sponsored efforts. These documented, completed results of Defense R&D contribute to technology transfer by helping private sector organizations identify DoD work in their fields of interest.

Technical Effort and Management System (TEAMS)

The DTIC-operated TEAMS WUIS database contains brief descriptions of ongoing Defense R&D efforts as well as the identity of the sponsoring and performing organizations, project duration, and level of resources invested in the effort. This information can provide the basis for identifying opportunities for collaboration between DoD organizations as well as between DoD organizations and the private sector for the purpose of technology transfer.

DoD Information Analysis Centers (DoD IACs)

The DoD IAC Program provides access via the World Wide Web (WWW) to 13 DTIC sponsored centers and one Army sponsored center for the analysis of scientific and technical information. Each IAC Home Page continues to experience a steadily increasing volume of inquiry traffic from the public sector. WWW access provides significant opportunity for technology transfer of publicly accessible defense technical information plus a channel for two-way electronic communication with technology experts.

F. INDEPENDENT RESEARCH AND DEVELOPMENT (IR&D)

In FY 98, the DoD continued to make progress in improving the management of IR&D and improving communications with industry. Section 2372(c)(3) of Title 10 USC provides for reasonable and timely communications of 1) DoD's planned or expected future needs to contractors, and 2) contractors' progress on IR&D programs to the DoD.

Policy and Management

The Military Departments have always had vigorous IR&D programs. To provide coordinated leadership for IR&D activities, in 1996, DoD established a senior executive Technical Coordination Group (TCG) consisting of representatives from OSD and the Military Departments. In 1998 the TCG continued to provide the leadership and coordination necessary to maintain an effective IR&D program. For example, industry uses defense technology planning and requirements information provided by DoD to plan IR&D support of defense needs. The leadership provided by the senior management team continues to enhance DoD's responsiveness in meeting industry's information needs. The TCG and industry representatives meet periodically to foster improvements in communications both within DoD and between DoD and industry.

DoD IR&D policy is promulgated in DoD Instruction 3204.1, "Independent Research and Development (IR&D) and Bid and Proposal (B&P) Program." In 1998, DoD revised this DoD Instruction as a DoD Directive to bring policy guidance in line with current law and program administration. Once issued, the new document will update DoD policy and practices regarding management of IR&D, providing guidance to the Military Departments. In addition, the DoD Directive will formally charter the TCG.

During 1997, OSD completed an evaluation of the IR&D program. The evaluation focused on the impact changes in regulations and policy had on the IR&D program. During 1998, the evaluation's results guided actions to further improve both program oversight and communications with industry. For example, the evaluation reviewed how industry reports IR&D project data to the Defense Technical Information Center (DTIC) using codes identifying related research areas. DoD then links the reported IR&D data with DoD's technology areas. This mapping of IR&D data to the technology areas helps the DoD assess how industry research will support future DoD technology priorities. In addition, the evaluation study exposed a disturbing industry trend toward short-term research and away from long-term research. Actions addressing the evaluation study's findings are underway.

Technical Communications from Industry

Until FY 93, IR&D project descriptions from contractors were made available to the DoD only in hard copy and summary descriptions in an on-line database maintained on a mainframe computer at DTIC. In FY 93, DTIC began to distribute, for government employees only, a streamlined electronic version of the IR&D project descriptions on CD-ROM media for the Microsoft Windows platform. Each year, DoD and industry contributors have further streamlined the process. Contributing industry contractors now prepare the project descriptions on personal computers and submit them electronically. As a result, data preparation and submission costs for contractors have decreased significantly.

The CD-ROM contains over 4,000 technical project summaries valued at approximately $2.5 billion. These submitted projects represent almost 90% of the cost recoverable

IR&D efforts by defense contractors. Company submissions to the DTIC database are voluntary. DoD continues its efforts to get as many of the DoD contractors as possible to submit IR&D data. Letters to non-submitting contractors explaining the potential value of these reports often results in more data submissions. Over 200 copies of the IR&D CD-ROM, containing proprietary data, are distributed each year within DoD. Users of the data can be found in Defense laboratories, systems commands and program offices. To foster communications between DoD and industry engineers, DTIC provides the IR&D CD-ROM distribution list to industry. DTIC is now developing a restricted access World Wide Web site to distribute the IR&D data to authorized users. Resolving the information security issues will improve the cost effective distribution and access to IR&D data.

Defense Planning Documentation for Industry

The Department makes many technology planning documents available to Defense contractors. The Defense contractors find this information valuable in making business decisions and planning IR&D programs. IR&D web pages provide access to unclassified documents for searching, viewing, and downloading by Government activities and DoD contractors only. DTIC maintains the main IR&D web site (http://www.dtic.mil/ird/) and includes links to Military Service information, for example, to unclassified documents available through the Navy Acquisition Research Information Center (NARDIC).

Matching Defense Requirements to IR&D Technologies

IR&D records provide a source of information for technology options that may address particular emerging military requirements. A formal search of IR&D records at the staff level can be an effective means of matching service technologists with industry points of contact (PoCs), particularly when those industry PoCs are nontraditional suppliers for the Service in question.

For example, the Air Force develops information on their infrastructure requirements and Air Force Material Command staff actively search the IR&D CD-ROM database to match industry research efforts against those infrastructure requirements. Where these searches identify a possible interest, points of contact at the requiring Air Force activity and the industry contributor are connected.

The Army's strategy for matching its requirements to emerging IR&D technologies includes extensive use of executive conferences and technical interchange meetings with industry. In addition, the Army widely distributes the CD-ROM database to its scientists and engineers, and Army Research Laboratory managers who support acquisition systematically compare their technology needs to the CD-ROM.

The Navy seeks to leverage IR&D investments by a process in which acquisition program managers are directly involved in searches of the IR&D CD-ROM to match industry research efforts against their S&T requirements. The Navy believes these program managers are in the best position to determine relevance of the reported IR&D to their needs.

G. TITLE III OF THE DEFENSE PRODUCTION ACT

The Defense Production Act (DPA) (50 U.S.C. App. 2061 et seq.) is the primary legislation to ensure the timely availability of industrial resources and critical technology items that are essential for national defense. The mission of Title III of the DPA is to establish, modernize, or expand domestic production capability and capacity for technology items, components, and industrial resources that are essential for national defense and for which either no domestic capacity exists or it is insufficient to meet defense needs. Title III accomplishes this by providing domestic industry with a variety of financial incentives, which reduce the risk of establishing the needed capacity. These incentives include the use of purchases or purchase commitments, loans and loan guarantees, and the purchase or lease of advanced manufacturing equipment which can be installed in government or privately owned facilities. Purchases and purchase commitments are the incentives used most frequently.

The Title III Program is unique among DoD programs since it is the only program specifically aimed at establishing or expanding domestic production capacity. Furthermore, Title III has proven to be an exceptionally effective tool for transitioning new technologies from the laboratory to the factory floor.

Title III is organized and executed as a DoD-wide program. Title III efforts generally focus on materials and components that can be used in a broad spectrum of defense systems. The Title III Program undertakes projects that have multi-system application and enables these programs to acquire materials that would otherwise be unavailable or too expensive. The Office of the Secretary of Defense provides top-level management, direction, and oversight. The Air Force is the Executive Agent for the program and is responsible for the execution of approved and funded projects.

During 1998 the Title III program began development of three new projects in addition to continuing to execute six existing projects. The cumulative value of all active Title III projects exceeds $90 million.

Project Activities Initiated in CY 1998:

Power Semiconductor Switching Devices

The objective of this effort is to expand production capabilities for Power Semiconductor Switching Devices (PSSDs). PSSDs are solid-state devices that can be used to replace conventional electro-mechanical switches in medium and high-power electrical applications. They provide increased switching efficiency, reliability, and power handling capability with the additional benefit of reducing acquisition and life-cycle costs for both military and commercial applications. This project will focus on optimizing quality, performance, reliability, and availability with improvements in PSSD affordability. Avionics, missiles, and C3I applications will dominate the initial military demand for PSSDs. These devices will remove a major barrier to the replacement of hydraulic systems in aircraft, ships, and ground combat vehicles with more efficient, reliable electrical controls. PSSDs will also facilitate the development of compact, lightweight power supplies for directed energy weapons and electro-magnetic launchers.

This project is valued at $12.0 million, of which, the contractor is cost sharing $2.3 million. The project will promote an increase in domestic production capacity in MOSFET turn-off™ Thyristor PSSDs from 5,000 devices/year to over 15,000/year and an increase of the Full Light Silicon Sandwich PSSD production rate from 300 devices/year to over 1,200/year. A contract was initiated in August 1998 with Silicon Power Corporation of Malvern, PA. The project is scheduled to be completed in December 2003.

Silicon-on-Insulator Wafers

The intent of this project is to establish a domestic source of Silicon-on-Insulator (SOI) wafers to satisfy current and future defense requirements. New SOI materials significantly improve the performance of electronic devices used in defense systems and are used to fabricate low power and/or radiation tolerant devices. The inability of industry to scale up to production-level processes has created a situation where advanced SOI materials are either unaffordable or unavailable. This project will establish domestic sources for SOI substrates that have emerged from R&D, but which require lower-cost, higher-volume production capabilities before they can be affordably inserted into DoD systems. The project will concentrate on the development of wafers up to eight inches in diameter.

The SOI project is expected to be initiated in March 1999 and will cost approximately $7 million over a three-year period. It will promote the creation of a production capacity for SOI wafer material of 1.4 million square inches per year.

Silicon Carbide Substrates

This project will establish a viable, world-class domestic manufacturing capability for Silicon Carbide (SiC) semiconductor substrates. It will enable the transition to full scale manufacturing by establishing the capability to produce 75mm diameter SiC substrate wafers for semiconductor device fabrication. The Title III SiC project will improve affordability and quality through improvements in boule and wafer manufacturing processes. Military systems will be targeted for SiC technology insertions and DoD investments will be leveraged by requiring the Title III contractor(s) to enter into relationships with potential SiC device fabricators.

The Title III SiC project will cost approximately $7 million and includes a contractor cost sharing requirement. A contract award is anticipated in May 1999.

On-going Projects:

High Purity Float Zone Silicon

High Purity Float Zone (HPFZ) silicon is vital to the manufacture of infrared laser seeker detectors, vidicons, and high-power switching devices. It has purity and quality requirements 1,000 times greater than those required for the most advanced electronic silicon semiconductor applications. While this is a pervasive technology in U.S. defense systems, at the time of this project's initiation, in 1993, there was no domestic producer of HPFZ silicon.

The Title III HPFZ contractor, Unisil Corp., has demonstrated a capability to produce float-zone silicon at production rates. Its production process has achieved ISO 9002 registration. Using the Title III incentives, the contractor implemented technical improvements, cost reduction, and marketing efforts to achieve the project's production capacity goal of a minimum of 6,000 kgs of HPFZ silicon per year.

The government's investment of $10.9 million was matched by an $8 million capital investment by the contractor. This project will be completed in April 1999.

Flat Panel Cockpit Displays

This Title III project constitutes a portion of the National Flat Panel Display (FPD) Initiative, a program designed to develop competitive domestic suppliers and provide early, assured, and affordable access to FPD technology for the DoD. Title III provided various defense programs with a total of $25.8 million in financial incentives to facilitate and/or accelerate the insertion of FPDs into military cockpit avionics and other defense applications.

Title III successfully assisted the Apache Longbow helicopter program, one of the seven defense systems receiving Title III incentives, to qualify FPDs to replace Cathode Ray Tubes (CRTs). Apache Longbow constitutes a demand of more than 4,000 FPDs, plus a potential for up to 1,000 units in foreign military sales. The initial Title III investment was leveraged into a $300 million demand for domestic FPD producers. Nearly 1,100 FPD panels will be ordered as much as two to three years earlier than anticipated.

Small Flat Panel Displays

This project also constitutes a portion of the National Flat Panel Display Initiative. It is an effort to qualify a small format active matrix electroluminescent flat panel-based night vision heads up display (HUD) system for Special Operations Forces (SOF) applications. The HUD system was flight qualified on the MH-60Q and additional qualifications will be performed on the C-141B, MC-130P/N, MC-130E, and other Navy and Army platforms through February 1999.

The test results, under this $875 thousand dollar contract with Marconi/Tracor, have been extremely positive. Air Force SOF qualification results led to the identification of a requirement to purchase 100 displays.

Titanium Metal Matrix Composites

This Title III project will establish a production capability for continuously reinforced, silicon carbide fiber/titanium metal matrix composite (Ti MMC) material, targeted to the insertion of Ti MMCs in aircraft jet engines. The project will focus on demonstrating the production capability for cost-effective Ti MMC material fabrication processes, component manufacturing, and the necessary component fabrication testing and data generation sufficient for insertion of production ready components into the jet engine structure. Production insertion of Ti MMC components is the primary goal of this activity.

The key objectives of this project are to establish a viable domestic production base for Ti MMCs, demonstrate a cost of $1,600 per pound at a capacity of 2,500 lbs/year, and provide incentives for insertion opportunities to stimulate demand for Ti MMCs. A cooperative agreement was signed in August 1996 with the Titanium Matrix Composites Turbine Engine Components Consortium (TMCTECC) for $25 million, with a matching TMCTECC cost-share of $25 million. The project is scheduled to be completed in September 2000.

Aluminum Metal Matrix Composites (Al MMCs)

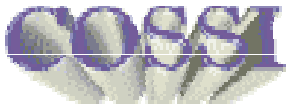
The objective of this Title III project is to design and test prototype Al MMC track shoes for the Bradley Fighting Vehicle. The project will demonstrate that Al MMCs provide an optimal cost/performance alternative approach to fabricating military components by combining a low cost, high performance silicon carbide whisker reinforcement with the high volume, near net shape processing capability of squeeze casting. The Army Tank-Automotive and Armaments Command is executing the project via a contract with Advanced Refractory Technologies, Inc. This project was initiated in January 1998 and will be completed in December 2001. General Motors is providing key subcontractor support for this effort. The value of this project is $3 million.

Semi-Insulating Indium Phosphide Wafers

This Title III project will establish an economically viable, domestic, world-class production capability for Semi-Insulating Indium Phosphide (SI InP) wafers. SI InP is a compound semiconductor material critical to a variety of optoelectronic and very high frequency, millimeter wave, and high power microwave electronics. The existing manufacturing infrastructure for InP wafer production is incapable of meeting defense requirements for quality, price, size, and availability. Increased domestic production capacity for InP is required to support current and future needs for both military systems (such as BAT, BCIS, MILSTAR, GPS, MILSATCOM, GBR, and F-22) and commercial applications. Title III incentives will be used to enable the transition to full scale manufacturing, improve quality and affordability, target military systems insertions, and leverage government investments.

In May 1997 contracts were signed with American Xtal Technologies, Inc. and M/A-COM, Inc. for the InP project. This effort will be completed in October 1999. The Title III investment is $5.5 million, with a contractor cost sharing contribution of $3.6 million. The project objective is for each contractor to achieve an InP production capacity of 50 thousand square inches of 75mm diameter SI InP wafers per year.

H. COMMERCIAL OPERATIONS AND SUPPORT SAVINGS INITIATIVE (COSSI)



The purpose of the COSSI program is to reduce Department of Defense (DoD) operations and support (O&S) costs by developing, testing, and inserting commercial technologies into fielded military systems on a routine and expedited basis. As the service lives of military platforms are extended, the cost of maintaining those systems increases. In addition, some military-specific components in those systems have become obsolete and hard to get at any price. Using commercial items adapted to function in military systems (instead of military unique items) can reduce maintenance costs and improve system performance. The use of commercial components also permits DoD to reduce parts inventories, obtain rapid delivery from commercial suppliers, and "upgrade through spares" as new technologies become available. Moreover, because the commercial supplier underwrites the cost of developing the commercial component, DoD saves on R&D expenses. Reducing O&S costs on fielded systems will make more financial resources available for new system acquisition and is an essential ingredient in DoD's modernization strategy.

The COSSI program began in FY 97 as part of the Dual Use Applications Program. In FY 98, the program office was placed under the Office of Technology Transition. OTT recently supported a joint Service solicitation for new COSSI projects. Proposals were submitted for all three Services as well as several joint projects and are currently being evaluated.

Thirty projects were selected in the first round of COSSI projects in 1997. These represented a development and qualification cost to the Government of $96 million. The proposers agreed to underwrite $89.9 million in additional costs of the projects. If all these projects succeed and are procured by the Services, the Government is estimated to save over $3 billion in O&S costs over 10 years.

Forming Partnerships With Industry

COSSI establishes Government and industry partnerships. Projects are cost-shared between the Government and industry reducing the expense of developing and qualifying a commercial product for use in a military system for each partner. It also signifies the contractor's commitment to the long term success of the project. By involving commercial and "dual use" suppliers, COSSI is making a small but important step in a process of creating an integrated military and commercial industrial base.

COSSI projects use Other Transactions for Prototypes Agreements rather than traditional Government procurement contracts. The authority to use such agreements was given to the Services by Section 804 of the Fiscal Year 1997 Defense Authorization Act (P.L. 104-201). This type of agreement has fewer regulatory requirements and is less burdensome than Federal Acquisition Regulation (FAR) contracts. It is also more compatible with best commercial practices. Many of the proposals submitted in response to COSSI solicitations came from non-traditional defense manufacturers, so in an era of consolidation, COSSI is expanding the potential sources providing materiel to DoD.

Projects are pursued as a public-private partnership, with shared goals and mutually acceptable milestones. Progress payments are made as observable technical milestones are achieved. Either party can terminate the project if it becomes apparent that the

agreed upon goals cannot be met. The Government's funding support is capped, although industry may increase its contribution if needed.

The COSSI Process

COSSI is a two stage process. In Stage I, firms or teams that include at least one for-profit firm submit proposals. The proposal must also include the written support of a "Military Customer" who has the authority to modify the system and purchase the kits in Stage II. During Stage I, modifications are made to the core commercial product to adapt it for military use. The item is then tested to ensure it performs satisfactorily in the selected application and operational environment, with no degradation in overall system performance. Stage I takes approximately 24 months to complete. If Stage I is successful, the military customer may then use procurement funds to contract for reasonable production quantities in Stage II.

The goal of the military customer in Stage II is to purchase the components without recompetition at a fair and reasonable target price, using Federal Acquisition Regulation Part XII, Commercial Items. Commercial item purchases do not require vendors to provide detailed cost or pricing data. Commercial firms generally do not operate on cost-accounting standards that traditional Government suppliers typically use. Using Generally Accepted Accounting Procedures in lieu of government Cost Accounting Standards encourages non-traditional defense contractors to participate. Section XII of the FAR permits price (as opposed to cost) based procurements for commercial items that have been slightly modified for military use.

COSSI Technical Categories

COSSI projects comprise several broad technical categories. The application of commercial electronics and software to replace military specific items is the largest and potentially most rewarding area. It includes open system architectures, computers, standard commercial interfaces, and easily maintainable software. Other categories include advanced materials, diagnostics and test equipment, and design and manufacturing.

Examples of COSSI Projects

The following examples illustrate the benefits expected from COSSI projects.

Mini-MUTES Replacement Processor

The AN/MST-T1(V) Mini-MUTES is an Air Force Electronic Warfare training system that emits electromagnetic signals that simulate threat radars so aircrews can practice countering these systems. Mini-MUTES relies on an aging proprietary computer processor that requires a continuously controlled environment. This COSSI project is to replace the obsolete hardware and rehost its software on a robust VME bus based system. Without COSSI, the Mini-MUTES system, worth $275 million, would have to be replaced prematurely, necessitating a development estimated to cost over $100 million. With COSSI, the Mini-MUTES training system will remain useful and supportable at least until 2015. In addition, by inserting a VME based architecture, system reliability will increase dramatically, significantly reducing the costs associated with lost training missions when the system is unavailable to train aircrews.

Commercially Based Processing for the F/A-18 (C/D)

The current architecture for the mission computer in the F/A-18 (C/D) requires software upgrades to be done in assembly language. This project will replace the current mission computer with a commercial processor and operating system allowing software upgrades to be done in a higher order language. Additionally, the project will employ widely accepted interface standards. As a result, the O&S costs for maintaining and upgrading the hardware and software will be reduced by over $400 million. The Department is investing $14 million and the commercial company is investing over $22 million during Stage I. This project will increase reliability and enable the F/A-18 (C/D) to constantly improve performance through adoption of a commercial innovation path.

Switchable Eyesafe Laser Rangefinder/Designator

This project will insert commercially-based solid state diode laser technology into the mast mounted sight of the OH-58D Kiowa Warrior. This technology was developed for commercial printing, lithography, and medical applications. The mast mounted sight's current laser suffers from decreasing reliability and parts obsolescence problems. The Department will invest $3 million and the commercial company will also invest $3 million to cover the costs of non-recurring engineering, testing and qualification. The current laser rangefinder designator is one of the Kiowa Warrior's leading sources of operations and support costs and the solid state diode laser design is expected to improve the reliability over the current laser system by a factor of 20. The expected improvements in reliability are projected to generate over $100 million in O&S savings over 10 years, provide a 30% improvement in target designation, and provide a laser rangefinder that is eyesafe.

Affordable AH-64 Apache Main Rotor System

This project will insert an existing commercially based helicopter rotor system, including composite blades, into the Apache helicopter. The current Apache Longbow upgrade adds weight to the helicopter. The new rotor system will accommodate the heavier weight better than the current rotor system, significantly increase fatigue life, and facilitate repairs. The project also applies commercial certification processes and standards, reducing development and qualification costs and time by 20-30%. This streamlined process could potentially lead to the establishment of a standard joint military-commercial certification program. The Department and commercial vendor will each invest $11 million for the design and testing of the new rotor system. The increased reliability and ease of repair is estimated to generate over $200 million in operations and support savings.

Data Distribution Kits for Command Centers

This project replaces an obsolete, defense-unique, data distribution network for mobile command centers with current commercial technologies using open architectures and standard commercial interfaces. The project targets components responsible for escalating operations and support costs. The Department will invest $4 million and the commercial vendor will invest $2.2 million in the design and testing of this technology. O&S savings are estimated at $41 million over 10 years. The new network will use commercial high-speed asynchronous transfer mode (ATM) technology and associated COTS products. The project utilizes open standards, which will result in long-term supportability and facilitate interoperability with other commercial products for future integration.

Appendix A: **P.L. 102-484, Section 4225, 10 USC 2515, Office of Technology Transition**

National Defense Authorization Act for Fiscal Year 1993
(Enrolled Bill (Sent to President))

SEC. 4225. OFFICE OF TECHNOLOGY TRANSITION.

(a) ESTABLISHMENT- Subchapter III of chapter 148, as amended by section 4224, is further amended by inserting after section 2514 the following:

`Sec. 2515. Office of Technology Transition

`(a) ESTABLISHMENT- The Secretary of Defense shall establish within the Office of the Secretary of Defense an Office of Technology Transition.

`(b) PURPOSE- The purpose of the office shall be to ensure, to the maximum extent practicable, that technology developed for national security purposes is integrated into the private sector of the United States in order to enhance national technology and industrial base, reinvestment, and conversion activities consistent with the objectives set forth in section 2501(a) of this title.

`(c) DUTIES- The head of the office shall ensure that the office—

`(1) monitors all research and development activities that are carried out by or for the Military Departments and Defense Agencies;

`(2) identifies all such research and development activities that use technologies, or result in technological advancements, having potential nondefense commercial applications;

`(3) serves as a clearinghouse for, coordinates, and otherwise actively facilitates the transition of such technologies and technological advancements from the Department of Defense to the private sector;

`(4) conducts its activities in consultation and coordination with the Department of Energy and the Department of Commerce; and

`(5) provides private firms with assistance to resolve problems associated with security clearances, proprietary rights, and other legal considerations involved in such a transition of technology.

`(d) REPORTING REQUIREMENT- The Secretary of Defense shall submit to the Committees on Armed Services and on Appropriations of the Senate and the House of Representatives an annual report on the

activities of the Office at the same time that the budget is submitted to Congress by the President pursuant to section 1105 of title 31. The report shall contain a discussion of the accomplishments of the Office during the fiscal year preceding the fiscal year in which the report is submitted.'.

(b) SCHEDULE FOR ESTABLISHMENT- The Office of Technology Transition shall commence operations within 120 days after the date of the enactment of this Act.

(c) REPORTING REQUIREMENTS- (1) Not later than 180 days after the date of the enactment of this Act, the Secretary of Defense shall submit to the congressional defense committees a report on the establishment of the Office of Technology Transition. The report shall contain a description of the organization of the Office, the staffing of the Office, and the activities undertaken by the Office.

(2) Notwithstanding section 2515(d) of title 10, United States Code (as added by subsection (a))—

(A) the first report under that section shall be submitted not later than one year after the date of the enactment of this Act; and

(B) no additional report is necessary under that section in the fiscal year in which such first report is submitted.

Appendix B: **DoD Laboratories' Technology Transfer Activities**

Number of Reported Active Technology Transfer Mechanisms*
per Service/Agency

Service	FY 95	FY 96	FY 97	FY 98
Army	552	639	684	795
Navy	148	139	297	387
Air Force	53	42	342	393
Defense Advanced Research Projects Agency	2	2	19	17
National Imagery and Mapping Agency	0	0	2	4
TOTAL	**755**	**822**	**1,344**	**1,596**

* Technology Transfer Mechanisms include Cooperative Research and Development Agreements (CRADAs), Patent License Agreements, Use of Facility Agreements, and Personnel Exchange Agreements.

Number of Reported Active Technology Transfer Mechanisms by Laboratory/Center
FY 95 through FY 98

Laboratory/Center	FY 95	FY 96	FY 97	FY 98
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY	2	2	19	17
ABERDEEN TEST CENTER			3	2
AERONAUTICAL SYSTEMS CENTER, WRIGHT-PATTERSON AFB			6	6
AIR FORCE DEVELOPMENT TEST CENTER	1	2	8	3
AIR FORCE FLIGHT TEST CENTER	5	6	8	13
AIR FORCE MEDICAL CENTER, WRIGHT-PATTERSON AFB			2	2
AIR FORCE MATERIEL COMMAND	17	24	87	72
ARMY AEROMEDICAL RESEARCH LAB	9	17	17	20
ARMY ARMAMENT RESEARCH DEVELOPMENT AND ENGINEERING CENTER	10	20	27	40
ARMY AVIATION RESEARCH AND TECHNOLOGY ACTIVITY	31	38	7	16
ARMY AVIATION RESEARCH DEVELOPMENT AND ENGINEERING CENT	2	2	2	2
ARMY CECOM INTELLIGENCE AND ELECTRONIC WARFARE DIRECTOR	6	7	10	11
ARMY CECOM RESEARCH DEVELOPMENT AND ENGINEERING CENTER	22	29	30	34
ARMY COMMUNICATIONS-ELECTRONICS COMMAND	4	6	12	11
ARMY ELECTRONIC PROVING GROUND	1	1	1	1
ARMY ENGINEER WATERWAYS EXPERIMENT STATION	22	27	43	56
ARMY INSTITUTE FOR SURGICAL RESEARCH	1	1		4
ARMY MEDICAL RESEARCH AND MATERIEL COMMAND (PROVISIONAL)	8	6	5	6
ARMY MEDICAL RESEARCH INSTITUTE OF CHEMICAL DEFENSE	1	2	1	1
ARMY MEDICAL RESEARCH INSTITUTE OF INFECTIOUS DISEASES	57	66	66	70
ARMY MISSILE RESEARCH DEVELOPMENT AND ENGINEERING CENTER	6	10	11	15
ARMY NATICK RESEARCH DEVELOPMENT AND ENGINEERING CENTER	18	20	31	39
ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES	1	5	5	6
ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE	8	11	11	20
ARMY RESEARCH LAB	109	117	151	165

Laboratory/Center	FY 95	FY 96	FY 97	FY 98
ARMY RESEARCH OFFICE, RESEARCH TRIANGLE PARK			1	1
ARMY SPACE AND STRATEGIC DEFENSE COMMAND	3	4	2	1
ARMY TEST AND EVALUATION COMMAND, ABERDEEN PROVING GROUND			1	0
ARMY TEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT ACTIVITY	1			0
ARMY TOPOGRAPHIC ENGINEERING CENTER	3	2	2	4
ARNOLD ENGINEERING DEVELOPMENT CENTER	0	1	2	2
CENTER FOR HEALTHCARE EDUCATION AND STUDIES	2	1	1	1
CLINICAL INVESTIGATION REGULATORY OFFICE	30	38	34	95
COLD REGIONS RESEARCH AND ENGINEERING LAB	28	28	25	34
CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY)	33	34	39	48
DEFENSE LANGUAGE INST	4	5	4	3
EDGEWOOD RESEARCH DEVELOPMENT AND ENGINEERING CENTER	2	5	11	21
ELECTRONIC SYSTEMS CENTER	15	12	8	25
JOINT TRAINING ANALYSIS & SIMULATION CENTER, SUFFOLK			1	1
NAVAL AIR WARFARE CENTER AIRCRAFT DIV	10	10	14	20
NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISION, ORLANDO			2	7
NAVAL AIR WARFARE CENTER, WEAPONS DIVISION, CHINA LAKE	13	12	34	43
NAVAL AIR WARFARE CENTER, WEAPONS DIVISION, PT MUGU			6	9
NAVAL MEDICAL RESEARCH CENTER	33	32	39	45
NAVAL METEROLOGY & OCEANOGRAPHY COMMAND, STENNIS SPACE CTR			2	3
NAVAL POSTGRADUATE SCHOOL	8	7	6	9
NAVAL RESEARCH LAB	44	36	64	79
NAVAL SURFACE WARFARE CENTER DAHLGREN DIV	9	10	14	18
NAVAL SURFACE WARFARE CENTER DAHLGREN DIV. COASTAL SYS. STATION	2	2		2
NAVAL SURFACE WARFARE CENTER INDIAN HEAD DIVISION	8	8	9	14
NAVAL SURFACE WARFARE CENTER, CARDEROCK			14	18
NAVAL SURFACE WARFARE CENTER, CRANE, IN			8	10
NAVAL UNDERSEA WARFARE CENTER KEYPORT DIVISION	2	3	4	3

Laboratory/Center	FY 95	FY 96	FY 97	FY 98
NAVAL UNDERSEA WARFARE CENTER NEWPORT DIV	17	17	21	25
NAVY CLOTHING & TEXTILE RESEARCH FACILITY, NATICK			2	2
OFFICE OF NAVAL RESEARCH, ARLINGTON			39	45
OGDEN AIR LOGISTICS CENTER	2	4	24	12
OKLAHOMA CITY AIR LOGISTICS CENTER	0	1	1	1
SAN ANTONIO AIR LOGISTICS CENTER, KELLY AFB			3	3
SPAWAR SYSTEM CENTER, SAN DIEGO	2	2	18	24
TACOM RESEARCH DEVELOPMENT AND ENGINEERING CENTER	31	33	28	37
TRADOC ANALYSIS CENTER	1	1	1	1
UNIFORMED SERVICES UNIV OF THE HEALTH SCIENCES	1	1	2	2
WALTER REED ARMY INST OF RESEARCH	83	84	89	104
WARNER ROBINS AIR LOGISTICS CENTER	4	4	8	13
WATERVLIET ARSENAL	11	15	8	13
WRIGHT LAB	6	10	73	22
YUMA PROVING GROUND	1	3	3	4

Some new activities began reporting data in FY 98. Additionally, the Air Force Research Laboratory began reporting using it's new title and Division designations. Therefore, these activities are reported below:

Laboratory/Center	FY98
Air Intelligence Agency	2
AFRL Munitions Directorate, Eglin AFB	3
AFRL Directed Energy Directorate, Kirtland AFB	26
AFRL Space Vehicles Directorate, Kirtland, AFB	12
AFRL Information Directorate, Rome, NY	9
AFRL Air Vehicles Directorate, WPAFB	19
AFRL Material Directorate, WPAFB	12
AFRL Propulsion Directorate, WPAFB	17
AFRL Sensors Directorate, WPAFB	8
AFRL Human Effectiveness Directorate, WPAFB	35
Naval Facilities Engineering Service Center, Port Hueneme, CA	2
Naval Medical Center, San Diego, CA	4
Naval Observatory, DC	1
Naval Surface Warfare Center, Port Hueneme, CA	2
Navy Experimental Diving Unit	1
White Sands Missile Range	1

Appendix C: **Service / Agency Highlights**

Army

The Picatinny Technology Transfer Innovation Center (PIC)

PIC was established in November 1996. PIC is a cooperative effort involving County College of Morris (CCM), the U.S. Army Armament Research, Development and Engineering Center (ARDEC), and state and local governments with the mission to 1) accelerate the successful development of growing high tech companies by providing access to technology, services, rental space, equipment and business resources, and 2) assist the ARDEC with technology transfer to the private sector by using the business incubator process. Participating companies are provided with affordable office space, and ready access to technical, management, and financial expertise. PIC has an impressive array of resources to provide participating companies with the competitive edge they need in today's market place.

Blanket CRADA with "Big 3" Automakers

The Tank-Automotive RDEC (TARDEC) has a "blanket" CRADA with the "Big 3" automakers (General Motors, Ford Motor Company and Chrysler) to facilitate the CRADA process to quickly and effectively enter into specific collaborative agreements. TARDEC is currently in a CRADA with the Ford Motor Company to evaluate vision enhancement devices that will help drivers see better in inclement weather or in conditions with low visibility. In addition to working with General Motors, TARDEC also had CRADAs with General Dynamics Land Systems, Autosense Ltd. and Collision Avoidance Systems to study blind-spot monitoring systems for vehicles to help avoid collisions. There are many blind spots all around a vehicle and they represent a serious hazard when drivers change lanes or merge with moving traffic. Results of these efforts could be applied to private and commercial vehicles, both large and small, and help to avoid many injuries each year.

Ceramic Ferroelectric Materials

ARL has entered into an exclusive patent license agreement with TRS Ceramics, Inc. of State College, PA, to manufacture ceramic ferroelectric materials patented by Army researchers. These novel materials act as low-cost, low-loss tunable dielectrics that can be employed in phased-array antennas, varactors, and a broad spectrum of communications electronics. It is estimated that these materials will cost 1/25 of the cost of the current ferrite phase shifters required for phased-array application. This cost reduction is accompanied by a 25 percent weight reduction. ARL is presently negotiating use licenses with a variety of private corporations interested in commercial applications of the ceramic. ARL also holds, and is presently marketing, several patents concerning ferroelectric devices that employ these materials.

Technology Transferred from Commercial Direct TV/Direct PC into the Joint Global Broadcast Service (GBS) while supporting CECOM Ku Uplink and Broadcast Management Center (BMC)

The GBS provides worldwide access to high volume information products via Commercial off the Shelf Technologies (COTS) proven technologies from Direct Broadcast Industry. The CECOM Ku Uplink BMC is a testbed facility for investigation of next generation satellite broadcast technologies as well as back-up operational facility to GBS functional Testbed. This facility proves a fully functional Global Broadcast injection capability in a laboratory environment. Consequently, it is ideally suited to experimentation and evaluation of "what if" technologies. The CECOM Ku Uplink BMC can also be used to support hardware and software development and testing to evaluate candidate new technologies and provide a back-up capability for the operational system. An example of the technology is the recent hosting and rebroadcast of the Discovery Shuttle Launch.

Construction Equipment Performance Optimization

U.S. Army Cold Regions Research and Engineering Laboratory has entered into a three party CRADA with Caterpillar, Inc., Peoria, IL, and Goodyear Tire and Rubber Co., Akron, OH, to develop a numerical model simulating the interaction between tires and deformable surfaces such as thawing and soft soils. Current tire models do not consider the interaction of the tire with deformable media such as soil or snow, focusing only on interactions with pavements. This project will integrate the experimental and numerical simulation of tractive loading on deformable terrain with numerical models of tire deformation resulting in a three dimensional finite element simulation of tire-terrain interaction. The expected result of this collaboration is a design tool with the capability to design tires that perform more efficiently on unpaved roads, off-road, and in all-season conditions including snow and thawing soils. In addition, the technology will be used to explore the effects of tire and terrain variables on vehicle performance and terrain damage.

The technology developed through this CRADA is truly a dual-use technology in that this tool can be a applied to the development of commercial as well as military products. In the commercial sector, the use of this tool will greatly improve the efficiency of off-road, mud and snow, and heavy vehicle tires, increase construction site productivity by improving vehicle traction, and therefore decrease cycle time, fuel costs, tire wear, and time lost due to immobilization, surface damage and repair or reclamation costs. DoD will use this tool to improve tire design and specification, improve performance prediction for off-road vehicles and provide the capability to predict rutting of and soil damage to unsurfaced roads and Army training grounds.

CORE-LOC Concrete Armor Unit

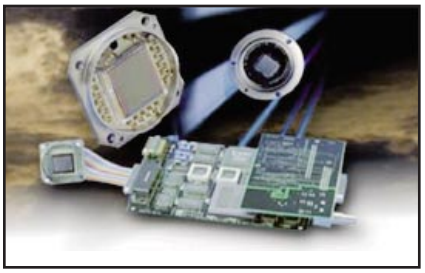
U.S. Army Engineers' Waterways Experiment Station (WES) entered into a CRADA with A. R. Wijnberg, South Africa, to gain the acceptance of CORE-LOC, an innovative coastal protection armor unit developed by engineers at WES by the coastal engineering community which is normally a very slow process. The cost of failure is typically so large that few are willing to risk trying new technology. CORE-LOC has several advantages over its competitors. A CORE-LOC armor layer has outstanding interlocking features and is extraordinarily efficient, dissipating the maximum amount of wave energy with the least amount of concrete, therefore requiring significantly less material than existing armor units. It also has a reserve stability that other structures don't have.

This CRADA allowed WES engineers to work with design engineers at A. R. Wijnberg in the model testing and prototype construction of the world's first breakwater built with CORE-LOC concrete armor units. The assistance provided by WES engineers was critical to the proper model testing of the CORE-LOC structure, as it was to the placement of CORE-LOCs on the prototype structure. A. R. Wijnberg was willing to recommend CORE-LOC for this breakwater and work with WES engineers to successfully conduct model tests and actually construct the breakwater at Port Saint Francis, South Africa.

A product commercialization that is application specific was achieved. Wijnberg's faith in the Corps of Engineers' product for protection for a peninsula and breakwater provided an early opportunity to field test the new armor unit. The early support for CORE-LOC has developed into an active foreign market. Money in the form of both royalties and reimbursable studies is helping to leverage WES' R&D funding.

This project greatly strengthened WES' negotiating position in licensing the CORE-LOC concrete armor unit. With projected royalties of $2.00 to $5.00 per metric ton, a single half-mile long breakwater built with 12 ton armor units could result in royalties of over $1/2-million. Each CORE-LOC unit weighs about 2 tons requiring these units to be built on site. Therefore, patent applications have been filed in over 40 countries and trademark applications filed in many others. The CORE-LOC concrete armor unit is now licensed to four companies, each having an assigned geographic territory. These territories include Europe and South America, North America, Japan, and South Africa. In the near future, annual royalties could easily exceed $1 million.

Evaluation of Electron Cyclotron Resonance (ECR) Plasma Technology



The U.S. Army Communications and Electronics Research, Development and Engineering Center, Night Vision and Electronic Sensors Directorate, (NVSED) entered into a CRADA with Texas Instruments, (TI) (now Raytheon) to further develop the next generation focal plane array by replacing the currently used method of liquid chemical etching with a vapor phase etching technique, Electron Cyclotron Resonance (ECR) etching. Army requirements for higher standoff distances and target recognition capability have led to concepts for next generation of arrays which will have a much higher pixel count than is present in the current generation.

In the CRADA it was agreed that TI would contribute the very high quality and many-layered mercury cadmium telluride samples which they routinely make. NVESD would then etch samples of these in its a state of the art ECR reactor. TI would then measure electrical and structural properties of the etched layers to assess suitability for the TI device architecture.
After one year the etching process looks promising. A few milestones towards developing the next generation FPA have been achieved. The etching process produced an FPA 128 pixels by 128 pixels with each pixel being 24 microns by 24 microns. TI has now purchased a plasma reactor in order to continue the research effort and will eventually integrate this technology into their future production line.

Formulation of a Liposomal Transdermal Vaccine System and Other Novel Pharaceuticals

The Walter Reed Army Institute of Research (WRAIR)and the Medical Technology and Practice Patterns Institute, Inc. (MTPPI) are collaborating in a CRADA to develop vaccine adjunct technology to devise an effective, safe and easily administered delivery mechanism for vaccination. MTPPI is dedicated to the development and transfer of medical technology through Vision for World Health Project. MTPPI has identified the need to introduce an alternative vaccine delivery system to reduce the cost and increase the accessibility of vaccination, especially in Third World settings. A transdermal vaccine delivery system fulfills this objective and is appropriate to the charters and goals of both WRAIR and MTPPI. A liposomal transdermal vaccine system would allow immunization without the need for sterile needles and syringes, trained personnel, and would avoid the complications associated with puncturing the skin.

As a result of this CRADA, a new means of transdermal vaccine delivery was discovered. An article on the technology has been published in Nature magazine. Two patent applications have been filed on inventions created under this CRADA and a third is in preparation. A major licensing agreement has been executed between WRAIR and MTPPI and sublicensing arrangements with commercial developers and end-users of the technology have begun. Substantial resources (revenues and professional scientific staff) have come into WRAIR under this CRADA with MTPPI.

The first trial to be conducted under this CRADA is for a vaccine of particular interest to the Army, E. coli endotoxin technology, for soldiers diarrhea. The vaccine will be used in field operations.

Efficacy of Advanced Infrared Sensor Technology in Medicine

A CRADA was established between Dr. Gorbach. Inc. and the U.S. Army Communications and Electronics Command (CECOM) Research, Development and Engineering Center (RDEC), Night Vision and Electronic Sensors Directorate, (NVSED) to actively collaborate with military and civilian medical research groups to investigate the efficacy of advanced infrared sensor technology in medicine. This initiative has led to over 20 human patients being imaged to date at NIH using NVESD's mid-wave infrared (MWIR) thermal imaging camera. The protocol has been approved for 50 patients, which should be accomplished over the next year. The thermal imaging technique has been used intraoperatively and has been successful in differentiating between intracranial lesions and normal functional tissue. In all cases so far, the technique localized the tumor and functional cortex. In all but 3 cases, the tumor was colder than the normal tissue. An increase in spatial resolution has been requested. Publication of results in a refereed medical journal is planned.

Advanced Modeling, Analysis and Simulation Environment (AMASE)

Monmouth University, under contract with the Army Research Office, is developing an object oriented modeling environment called Advanced Modeling, Analysis and Simulation Environment (AMASE). This model is capable of supporting system performance, engineering, and other types of models and simulations. As part of a CRADA between Monmouth University and the CECOM RDEC, Command/Control Directorate, a senior CECOM engineer participated in software design meetings with Monmouth University professors, gaining insight into concepts, rationale, and methodology required to write a model of this magnitude. Subsequently, the Army evaluated MODSIM III and its usefulness as an adjunct or interface into AMASE. This evaluation indicated that to interface usefully, external signals from AMASE would

have to control the internal MODSI clock, which is not being pursued at this time. CECOM also provides information to Monmouth University describing the new High Level Architecture(HLA) mandated by DoD for military models. CECOM assisted Monmouth University in evaluating AMASE compliance with HLA. After careful analysis it became apparent that the AMASE design is very similar to the HLA design, and compliance seems inherent.

Cheng Rotation Vanc (CRV)

A CRADA was negotiated between the CECOM RDEC and the National Institute of Standards and Technology (NIST) and Cheng Fluid Systems to evaluate the potential of a novel flow conditioning device called a Cheng Rotation Vanc (CRV) with a specific goal of objectively measuring the ability of the CRV to improve the accuracy of hot wire mass flowmeters located downstream of pipe elbow joints. The CECOM's interest in the CRV was based on the fact that an increase in accuracy of hot wire mass flowmeters in these systems could allow for a reduction in the factor of safety in the filter sizing resulting in a decrease of size and weight. This is very important for armored vehicles and helicopters.

Cheng Fluid Systems provided the CRV. NIST provided the laser anemometry facility and labor to conduct the test, process the data, and write a report. CECOM provided a laser anemometry system, a hot-wire anemometry system and bubble generation system and accompanying hard and software.

Based on the cooperative venture, the CRV could ultimately reduce the maximum error of the airflow controls in the cooling/nuclear, biological and chemical (NBC) system application by 10%. The joint research effort benefited DoD in that it offers a size and weight reduction for the advanced cooling/NBC integrated system that will protect future mission critical electronics from thermal degradation and NBC contamination. The CRADA validated the performance of the CRV in a typical military application.

Navy

Laboratories with significant patent activity have established Invention Evaluation Boards (EIBs) which evaluate the commercial potential of Navy patents. In addition, some Navy laboratories have proposed several patents to the "Laboratory to Market" program at the University of Baltimore, where they are reviewed for commercialization potential.

Weapons Team Engagement Trainer Laboratory Prototype

Collaboration continues between the National Institute of Justice and the Naval Air Warfare Center, Training Systems Division (NAWCTSD) to explore and develop simulation and other instructional system technologies which may rapidly impact the law enforcement community and identify training needs, co-development opportunities, and resource sharing strategies to address training deficiencies. A major effort under this program is the installation of the Weapons Team Engagement

Trainer laboratory prototype at the Naval Training Center, Orlando, for use by regional and federal military and law enforcement personnel.

Entrepreneurial Technology Apprenticeship Program (ETAP)

ONR funds the ETAP with the National Technology Transfer Center (NTTC) where students from HBCU/MIs are placed in the technology transfer offices of Navy laboratories. While there, they learn practical skills about technology management and contribute their knowledge and skills to the success of those offices. Seven students were placed in FY 96, five were placed in FY 97 and four were placed in FY 98. The Naval Surface Warfare Center, Indian Head Division received an award at the 1998 FLC meeting for participating in the ETAP.

Licensing Activity

The Naval Air Warfare Center, Weapons Division, (NAWCWPNS) signed one new PLA with Thermo Jarrell Ash Corporation (TJA) which is the direct result of a highly successful CRADA that resulted in four new patent applications. Under the patent License Agreement, TJA has a non-exclusive license for one NAWCWPNS pre-CRADA invention, and an exclusive license for the four inventions developed under the CRADA.

Patent Process

The Naval Surface Warfare Center, Indian Head Division (NSWCIHDIV), prepared a comprehensive "Patent Process" Instruction (IHDIVNAVSURFWARCENINST 5800.2). NSWCIHDIV's patent process changed from an ad hoc review to a formalized process for guiding a potential inventor through the total process of preparing required forms to internal and external review of invention disclosures, through the point where a patent is issued. The instruction also identifies when inventorship awards are given.

Patuxent Partnership

The Naval Air Warfare Center, Aircraft Division (NAWCAD), is a partner in the Patuxent Partnership which is a Southern Maryland support network for technology driven economic development which had its first full year of operation in 1998. During this year the partnership worked with NAWCAD to produce a publication, "Technology Partnership Opportunities," which is a plain-language catalog of NAWCAD technologies. In addition, the Patuxent Partnership produced "Commercialization of Navy Technologies: A Critical Analysis" which is a review of NAWCAD patents with commercial potential.

1-800-NAVYTEC

For the last several years ONR has maintained a 1-800 line (1-800-NAVYTEC) at the NTTC via which it attempts to match the technology needs of civilian firms with the technologies and technological expertise of the Navy laboratories.

Conrad Award

Annually ONR presents the Conrad Award, the Navy's highest honor for scientific achievement. The FY98 recipient was **Dr. Norman Owsley** of the Naval Undersea Warfare Center Division Newport. Noted in the citation was Dr. Owsley's technology

transfer efforts in applying sonar research to non-invasive diagnosis of coronary artery disease. This is the second consecutive year that an FLC Excellence in Technology Transfer Award recipient also received the Conrad Award.

Meteorological Satellite Application System

A satellite meteorological application software developed by the Naval Research Laboratory (NRL)-Monterey is being incorporated into the TeraScan software package marketed by SeaSpace Corporation. The Navy uses SeaSpace's TeraScan software on the Navy Satellite Display System-Enhanced at four regional centers throughout the world. A CRADA allows Navy operational forecasters faster and easier access to the NRL-developed meteorological application modules.

HAZMAT Protection Ensemble

The Naval Surface Warfare Center, Panama City site, has developed a head contact microphone (patent pending) for applications in the Navy Special Warfare community. Under a program with the Pittsburgh Fire Department, the Mid-Atlantic Technology Applications Center (MTAC) and the Mid-Atlantic Regional FLC organization, a prototype communication systems was embedded in a fire helmet and demonstrated. The Pittsburgh Fire Department believes this concept to be a breakthrough in fire fighting communications. As a result of a recent presentation in Pittsburgh before an audience of over one hundred firemen and manufacturers of fire fighting equipment, a CRADA was issued to Unconventional Concepts, Inc. for further development of a hazardous environment communication system.

Detection of Contraband Narcotics by Nuclear Quadrupole Resonance (NQR) (Follow-on CRADA: Fast Recovery Time Nuclear Quadrupole Resonance Detection)

The Navy has had a general interest in advanced detection capabilities for narcotics for use with its own forces. In a CRADA between the Naval Research Laboratory and Quantum Magnetics, the objective was to look at using quadrupole resonance to detect heroin hydrochloride and cocaine hydrochloride. The signal, however, was very difficult to see. It was determined that the objectives of this CRADA were too aggressive. Therefore, a second CRADA was initiated to focus on specific advanced circuitry, a rapid recovery receiver, to detect narcotics and explosives. NRL has evaluated the circuitry and has given the data to Quantum Magnetics. NRL will keep the circuit for two years for laboratory use.

The advanced circuitry studied in this CRADA will be incorporated into a larger commercial system which will result in a better scanner than what is currently available. Working in partnership streamlined the advancement of knowledge in the applications of quadrupole resonance for explosive and narcotics detection.

Ocean Bottom Profiler (OBP) Joint Project

In a CRADA, the Naval Undersea Warfare Center, Newport Division, (NUWCDIVNPT) and Precision Signal, Inc., (PSI) collaborated to develop state-of-the-art equipment known as the Ocean Bottom Profiler, OBP. The OBP was to be capable of mapping the ocean floor in deep and shallow water as well as studying the geomorphology of the bottom by returning information on sediment layers

The Ocean Bottom Profiler program produced the 512 Sonar Vehicle which was first tested and modified at the NUWCDIVNPT laboratory for use in Narragansett Bay. As a

result of this testing and calibration, acoustic transducers, receiver arrays, and acoustic baffle materials were incorporated into the 512 design that have made the 512 profiler superior in performance to all bottom profiling vehicles worldwide.

Under this CRADA, NUWCDIVNPT and PSI have worked to develop a more complex Ocean Bottom Profiler that is capable of producing three-dimensional images of the sub-bottom sea floor. With this new vehicle, buried objects in the sea floor can be located and improved data for remote classification of the sea floor can be obtained. PSI and NUWCDIVNPT have worked to develop an array of receivers for electronic near-field beamforming objects in the sediment. Using previously developed acoustic transducer and acoustic baffle technology, a large, low frequency vehicle was constructed at PSI, and test data proved the feasibility of acoustic detection of buried objects in the sea floor. Acoustic sediment layers can now be measured in the ocean floor down to a level of 64 meters with a 9cm resolution. Today new, smaller, high frequency design of this vehicle is under development for use on Autonomous Underwater Vehicles (AUVs) to survey sea floor sediments and locate buried objects in remote shallow water locations.

The results of these efforts significantly contributed to the design of the AN/WSQ-9 Sonar System, a NUWCDIVNPT initiative that will soon provide significant new warfighting capabilities in mine detection to the U.S. Submarine Fleet. The first installation of this capability into a U.S. submarine is planned for FY99. The 512 Sonar Vehicle is a dual-use development used by many universities, commercial and military users to obtain quantitative and qualitative information on sea floor sediments. The 512 Sonar Vehicle is now manufactured and marketed worldwide by Edge Tech, Inc. under an agreement with PSI.

In the course of developing the OBP, valuable research was accomplished in the disciplines of acoustics and signal processing, as well as in electronic design, to achieve a multi-channel sub-bottom imaging device which could be incorporated into several different applications.

PSI designed an “in-hull” version of the OBP to be used on large vessels for both shallow and deep water applications. A system was installed on the RV Endeaver by PSI and used by Naval Research Laboratory (NRL) to survey sea floor sediments in coastal North Atlantic waters. The data from these surveys were used by NRL to develop a sea floor classification model using Biot theory. The program was successful and, as a result, the OBP is being considered for use in the U.S. Navy.

Air Force

During FY 98, the Air Force laboratories were reorganized into a single Air Force Research Laboratory (AFRL). The Air Force Technology Transfer Program is managed by the Air Force Technology Transfer Management Team located in the Technology Transfer Branch, Technology Transfer and Corporate Communications Division, Plans and Program Office, AFRL.

In FY 98 the Air Force rewrote its Air Force Policy Directive 63-1, Domestic Technology Transfer and its associated Air Force Instructions.

1-800-203-6451

The Air Force Technology Management Team manages the Air Force "Tech Connect" service (1-800-203-6451). Tech Connect receives telephone and e-mail inquiries from potential outside partners and searches for the Air Force technical experts in the laboratories and centers who can best answer the customer's technical questions. This coming year Tech Connect will continue to expand and improve its network of Air Force technical contact points. The Air Force Technology Transfer Management Team will work with the technology transfer focal points in developing and implementing technical assessment methodologies to proactively focus their transfer activities to target industry (i.e. medical, automotive, assistive technologies, etc.).

Master's Thesis

The Air Force sponsored one Air Force Institute of Technology student master degree thesis in the area of transfer process management: "A Return on Investment Model for Air Force Technology Transfer."

Wright Technology Network

The State of Ohio, Wright-Patterson AFB, and the local leaders in Dayton worked together and organized a not-for-profit corporation, Ohio Advanced Technology Center (OATC), in 1989 to promote and assist in the transfer of Wright Laboratory (WL) technology to predominately small and medium sized businesses in Ohio. In December 1994, WL signed an Intermediary Partnership Memorandum of Understanding (MOU) Agreement with OATC to "market" and assist WL technology transfer. A major change was the regional emphasis and national scope of their efforts. As a result the name was changed to Wright Technology Network (WTN). WTN now has representation in Indiana and Kentucky. WTN works with the AFRL to match technologies to the needs of industry, identify those technologies that have potential for commercialization, provide marketing expertise, and assist small business in solving problems or partner for a CRADA.

Gulf Coast Alliance for Technology Transfer (GCATT)

GCATT
Gulf Coast Alliance for Technology Transfer

GCATT is a partnership of federal laboratories, state universities, and community colleges in Northwest Florida and Southern Alabama. GCATT's mission is simply to foster commercialization of member technologies and to enhance regional economic development. GCATT provides a single point-of-contact to the commercial world for access to member technologies and commercialization support. This support is available to private sector firms, state agencies, and other entities. Both the Air Force Air Armament Center and the AFRL, Munitions Directorate (MN), are members of the GCATT. AFRL/MN, together with the Gulf Coast Alliance for Technology Transfer (GCATT) and the Southern Technology Application Center (STAC), has established a process to review MN technologies to identify the ones with the greatest potential for commercial application. During FY 98, AFRL/MN worked with STAC and GCATT to

develop a business plan for the explosive cutter technology. The ORTA successfully target marketed five oil service companies for the explosive cutter technology and chose Halliburton as the partner for commercialization of the technology.

The Alliance for Photonic Technology (APT)

APT has been formed by the Los Almos National Laboratory, Sandia National Laboratories, the University of New Mexico's Center for High Technology Materials and the AFRL, Phillips Research Site, to enhance the global competitiveness of U.S. Industry in the critical technology of photonics by accelerating transfer of federally funded technology developed by APT's R&D participants to industry. APT has been set up as a joint program hosted by the University of New Mexico. APT focuses on coordinating the technical responses of the R&D participants to the technology needs of U.S. Industry. It holds no assets and does no formal contracting. Contracts for technology transfer activities, including joint development, are executed directly between interested companies and the relevant APT R&D participants with ATP participants and APT's technical assistance.

Office of Technology Transfer for Education (OTTE)

In 1994, OTTE was established to assist in the transfer of technology from the Phillips Laboratory to educational institutions. Its mission is to identify and introduce AFRL related technology applications and expertise in support of national, regional, and local educational goals at all levels of education (pre-kindergarten through post-graduate) and through the use of strategic partnerships, foster cooperative relationships within education between the Space Vehicles (VS) and Directed Energy (DE) Directorates, other AFRL directorates, other federal agencies, and the private and public sector. For VS, this includes the developing and fostering of strategic partners with those educational institutions that enhance or support research in and/or understanding of autonomous operations power and thermal management, sensors and communication, electronics, and structures. For DE this includes research in lasers, optical imaging, high power electronic weapons, and protection technologies. Currently, OTTE has successfully negotiated 19 CRADAs and over 35 Educational Partnership Agreements (EPAs).

Yates Award

The team from the OTTE received the 1997-1998 General Ronald W. Yates Award for Excellence in Technology Transfer. The purpose of the award is to recognize a significant achievement by individuals and teams assigned to Air Force Materiel Command (AFMC) organizations in the movement of technology between AFRL and the public and/or private sector. Cash and in-kind investments by schools, communities, and businesses exceed $16M to date. Over 15,000 students at New Mexico schools have been impacted through these partnerships. Students' math, science, and writing skills improved an average of one letter grade through participation in the Computer Assisted Mathematics Instruction Project. The New Mexico Legislature acknowledged the success of the team with a memorial-recognizing landmark AFRL education partnerships. This recognition was prompted by the receipt of over 2,500 letters of appreciation from students, teachers, and principals.

Technet, Inc.

In 1996, the AFRL, Phillips Research Site, entered into an EPA with New Mexico's Technet, Inc. Under this agreement, the AFRL transfers surplus computer equipment deemed to be educationally useful to New Mexico Technet, Inc. These computers are evaluated, upgraded and distributed to primary and secondary schools by New Mexico Technet, Inc. for use in math, science, and technology education. To date, AFRL has donated personal computers, monitors, laptop computers, and printers to New Mexico Technet Inc. worth over $3M.

Technologies for Commercial Applications

The Air Force Technology Transfer focal points at several of the AFRL directorates are implementing a Tiger Team approach to review and catalog their technologies and facilities. This approach was initiated at the AFRL, Propulsion Directorate, to look at technologies for commercial applications. This approach not only identifies the technologies with the greatest potential for commercial application, but also highlights patents for tracking which could produce the greatest royalty potential. These Tiger Teams will meet annually to assess recently developed government technology to determine its application for transfer. The teams will prioritize the technology with respect to market assessment activities and targeted outreach efforts. A subset of this activity is identifying patents, which have originated in the AFRL and measure their impact (quality) for transfer (patent mapping). Once technologies are identified that are applicable, the ORTA will disseminate it in paper and electronic format to federal and state economic development and technology transfer organizations, plus interested companies.

At the AFRL, Sensors Directorate, the first step in the Tiger Team process was to brief the corporate board (consisting of the Director and the Division chiefs) asking for one representative from each division to participate on the team. A letter, signed by the Director, was sent to all S&Es instructing them to look at their technologies for any that had commercial potential. A questionnaire outlining main commercialization criteria was attached to the letter. These questionnaires were collected and reviewed. The Sensor Directorate Tiger Team consisted of two focal points, one representative from each division, two WTN personnel and one representative from the Wright Laboratory Technology Transfer Office. Weekly meetings took place to review the technologies. Each technology was briefed by a champion on the commercialization value of the technology. There were 22 technologies briefed. The team then developed a 13-point matrix to evaluate all the candidates equally. Each technology was then reviewed, discussed and voted on. This process resulted in 11 technologies being referred to WTN for commercialization assessment. WTN analyzed each technology and produced, and briefed, a final report that indicated 5 of the technologies had potential for commercialization.

Polyhedral Oligomeric Silsesquioxane (POSS)

One technology transfer success is the transfer of Polyhedral Oligomeric Silsesquioxane (POSS) polymer and monomer technology to the private sector. Currently POSS materials are being evaluated by the chemical industry through a CRADA the AFRL, Propulsion Directorate, has with the University of Dayton Research Institute (UDRI). POSS materials are being evaluated as additives to conventional plastic formulas to enhance wear resistance, increase fire safety, and provide greater strength to existing plastic products. The most attractive

feature of the POSS technology is that industry can gain these improvements without making major changes in manufacturing methods or purchasing new equipment. The polymer and plastic technology was initially developed for application to low-cost spacecraft components, rocket motor components, and other military aerospace needs. A CRADA was recently approved with Hybrid Plastics to further develop five Air Force inventions related to POSS technology and provide analytical services to the firm and other firms using Hybrid Plastics as a conduit. This CRADA will also support further development of rocket and aero propulsion technologies by enabling lower cost manufacturing of lightweight, high strength components incorporating POSS.

Whole Spacecraft Isolation System for Taurus/GEOSAT

The Air Force Research Laboratory (AFRL), Space Vehicles Directorate has been actively pursuing ways to reduce loads imparted to satellites. A concept developed at AFRL is a "whole-spacecraft isolation system" in which the vibrations imparted to the satellite are reduced. This system replaces the 60 bolts that attach the separation system to the avionics cone and exceeds or meets all performance requirements levied by Orbital Sciences Corporation (ORBITAL).

Under a CRADA between ORBITAL and AFRL, AFRL was to design, build and flight qualify a whole-spacecraft isolation system and ORBITAL was to fly the AFRL's isolation system on their Taurus/GEOSAT Follow-On (GFO) mission (GFO is a Navy satellite being built by Ball Aerospace). In return, ORBITAL would recover the GFO safety margins using the whole-spacecraft isolation system. This flight opportunity with ORBITAL occurred because the Navy satellite GFO had unsatisfactory stress margins on ORBITAL's Taurus launch vehicle, and the AFRL's whole spacecraft isolation system could significantly recover their stress margins.

Any reduction in launch loads corresponds directly to savings in satellite weight which can then be used for additional instruments to increase the science or performance of the satellite. Also, the extra weight can be used to add more propellant to the satellite; thereby, increasing the lifetime of the satellite. The whole-spacecraft isolation system helps reduce life-cycle costs of future Air Force satellite systems by significantly reducing the launch vehicle environments. It is projected that this system has saved the Navy GFO program a few million dollars and 3-6 months in redesign efforts. Similar results are expected for all other satellites launches.

Helmet Mounted Display Fitness of Use

Wearable computers and eye piece technology are stepping stones to providing maintenance technicians with the right information at the right time and place, enabling agile combat support. In a CRADA between the Air Force Research Laboratory, Human Effectiveness Directorate, and KOPIN Corporation, a Fitness of Use study was undertaken to examine the effectiveness of Helmet Mounted Displays (HMD) in mobile computing applications.

The two main elements in the fitness of use study included a visual effects study and a usability study. This CRADA provided KOPIN with access to an actual military maintenance environment for the evaluation of the HMDs for use as a maintenance tool. The Air Force was able to provide valuable feedback to KOPIN on the use of the HMD resulting in a commercialized product.

The information collected under this CRADA will be used to support Air Force Integrated Maintenance Information System (IMIS) efforts that are currently using portable computers for the display of maintenance technical information. Several of the IMIS programs in the Air Force (F-22 IMIS, F-16 IMIS, and JSTARS IMIS) are interested in monocular displays for possible outyear technology insertion.

Defense Advanced Research Project Agency

DARPA Reaches Milestone in Robotic Surgery:

The first robotic (telepresent) surgical operation on a beating heart without using a heart-lung machine was recently accomplished by Computer Motion. This is the "Holy Grail" of heart surgery, since performing the surgery without the use of a heart-lung machine reduces cost, complication and operating time by half. The telepresence surgery project was initiated by DARPA for battlefield use. In five years the system has been developed, commercialized and is now being used on patients in Germany, and is undergoing FDA review for approval in the U.S. NASA is now evaluating these systems for possible use on the International Space Station to allow researchers on earth to conduct their own experiments remotely (e.g., on plants and animals).

Commercialization of Fibrous Monoliths:

Inc. Magazine recently announced its Annual Inc. 500 Awards for 1998. Advanced Ceramics Research, Inc. (ACR) was named for its high rate of commercial growth over the past four years. ACR is the only high-technology, structural materials firm to make this prestigious list of the fastest growing privately held companies. ACR specializes in the production and fabrication of fibrous monolithic structural ceramic and metal matrix composites used in high-temperature applications. This technology, which was developed under DARPA sponsorship, greatly reduces the fabrication costs of high-performance composites for high-temperature leading-edge structures, rocket nozzle and turbine engine components, oil drill tooling and filtration products. ACR was founded nine years ago to develop hypersonic leading edge materials. It that time the company has moved from obtaining all of their funding from federal R&D spending, to today, when approximately 75 percent of their funding is from commercial/military product sales.

National Imagery and Mapping Agency (NIMA)

The Effects of the Gravity Disturbance Vector on Inertial System Accuracy

This CRADA provides a collaborative framework for the development and validation of an analytical model to analyze the effect of NIMA's gravity disturbance vector database on commercial GPS/INS Inertial Navigation Systems. This agreement will contribute to improvements in commercial INS systems.

Interactive Mapping on the World Wide Web Through the Use of JAVA Geospatial Components

This CRADA addresses the collaborative design and development of fully functional, highly interactive, geospatial prototype applications that are platform independent using JAVA geospatial components that can be deployed through the Internet, Intranet and Browser technologies. The agreement will produce JAVA modules for use with commercial market GIS applications.

Global Access, Dissemination and Assessment of Marine Navigation Services and Products

This CRADA addresses the global access, dissemination and assessment of NIMA Marine Navigation Products using IMARST A, B, and M mobile communications services. It provides for the development and validation of proof-of–concept Internet services which will allow commercial and private sector navigators direct access to Navigation Safety Data.

Simulated Aeronautical Flight

This CRADA provides for the collaborative development and validation of a commercial 3D terrain and aeronautical data visualization tool, which can be used on a PC. It will provide a commercially available 3D airfield approach and fly-through capability [based on Digital Terrain Elevation Data(DTED)].

Appendix D: **Small Business Innovation Research Program (SBIR) FY 98 Topic Descriptions**

U.S. Army Natick Research, Development & Engineering Center (Natick)
Technology Focus Area: Lightweight Warrior Systems
The dismounted soldier is central to all land operations. In order to accomplish his mission effectively he must be able to move efficiently over variable terrain. The soldier is overloaded by the weight of the items he must carry. This weight presently approaches 200 pounds which is unacceptable as a combat load. In an effort to reduce the combat load of the soldier, the U.S. Army Natick RD&E Center has identified seven topics that focus on technology areas where improvements can be made to reduce the load carried by the soldier. The focus area, Lightweight Warrior Systems, includes a range of technologies related to the sustainment, survivability, and support of the soldier. Individual topics include textile technology for multi-functional uniforms and garments, including composite technology for body armor, electronically conductive garments, sustainment systems, and power sources. The topics presented have wide commercial application in addition to military relevance.

OSD98-001
Title: Light Weight Warrior Protective Enclosures
Technology: Textile Technology
Objective: To apply tubular textile technology to produce a seamless 1-2 soldier enclosure that will provide the warrior with improved protection, reduced weight and cube.
Description: Recent breakthroughs in textile manufacturing technology have demonstrated the ability to fabricate seamless tubular textile structures. This effort will transition emerging technology to the manufacture of a seamless shelter suitable for 1-2 soldiers. Seamless technology will result in faster production rates (reduced cost), reduced weight, reduced cube, and the elimination of water leakage associated with seams.

OSD98-002
Title: Multi-threat Protective Uniform System
Technology: Multi-functional Textile Materials, Uniform Systems
Objective: To combine emerging material and system design/manufacturing technologies to develop a multi-layer, mission tailorable uniform system with the capabilities and protection necessary to address the environmental, chemical, flame/thermal, electrostatic, POL, and signature detection hazards that may be encountered on the battlefield of the 21st century across a broad temperature range at a 20 percent reduction in weight and bulk over current clothing items.
Description: The military has historically developed clothing items to defeat individual battlefield threats, e.g., cold weather clothing system, separate from a flame resistant uniform system. This results in a soldier requiring many layers of clothing, each providing a specific protection, which is also very heavy and bulky and inhibits soldier combat effectiveness. This effort should characterize the behavior and performance of a system by determining the cumulative effect of state-of-the-art/emerging material technologies on flame/thermal protection, environmental protection, and heat stress when combined at the uniform system level, and assessing the impact on the warrior performance.

OSD98-003
Title: Electro Optic Fabric Concepts for Combat Clothing
Technology: Microelectronics, conductive textile materials, fiber optics, and micro sensors
Objective: Integrate a conductive electronic/optical network within prototype garments constructed from wearable fabric.
Description: The first step in integrating microelectronics into the soldier system is to develop a wearable electronic network. The network will support sensor/monitor and actuator attachments and interconnections fed by a computer processor and transmitter. This effort will develop conductive network materials, sensor attachment techniques, and textile seaming methods and will result in the fabrication of prototype(s) ECG for proof of concept. The network may ultimately support a variety of environmental or chemical sensors, may provide for an active two way antenna system for transmitting and receiving voice/data information, or may supply power from a central battery to sensors remotely mounted to the soldier's extremities. Future alert detection systems may also require interconnection to a computer processor to signal the soldier of the presence of a mine, the enemy, chemical/biological agents, etc. [Note: Technologies developed may also be applicable to tentage and airdrop fabrics].

OSD98-004
Title: Elastomeric Perm-Selective Materials for Chemical Biological (CB) Protective Clothing.
Technology: Membrane Textile Technology
Objective: To develop, demonstrate, and transition elastomeric, selectively permeable materials that will serve as a foundation for one-size-fits-all garments.
Description: Chemically-resistant, waterproof, and breathable polymeric materials with unusually high stretch-and-recoverable ratio and low creeping behavior will be developed for use in the development of a new generation of CB protective clothing and closure systems. This will eliminate the need for overgarment, undergarment, and multiple garment sizes thereby reducing costs, weight, and logistic concerns and problems that soldiers currently face. Selecting a "right" polymeric material that has properties and characteristics as mentioned above has been identified as a major challenge in developing a closure system for CB protective clothing.

OSD98-005
Title: Pocket-stove
Technology: Combustion
Objective: To develop a pocket sized stove that will burn logistics fuels (diesel and JP8) to provide hot water for dehydrated rations, beverages (coffee and cocoa) and limited personal hygiene, and provide basic technology for small heat driven devices including, personnel warmers, heat driven coolers (microclimate and beverages), lanterns, thermophotovoltaic generators, and infrared markers.
Description: Soldiers have no acceptable method for heating water. Trioxane fuel bars have historical supply problems. Commercial camp stoves (8-10K BTU/hour) are too large and heavy for infantry, and none will burn diesel fuel. Accordingly, new approaches and new technology must be explored that will enable a pocket sized stove with an output of 1-2K BTU/hour weighing not more than 4 ounces (2 ounces desired), that connects to a standard fuel bottle (i.e., commercial), that can heat 16 ounces of water in a canteen cup to 100˚F in less than ten minutes, and that will cleanly and safely burn diesel and JP8.

OSD98-006
Title: Evaluation Environment for Light Weight, Low Power Concepts
Technology: Engineering Modeling, Simulation, Computer Aided Design
Objective: To investigate and develop a prototype Virtual Evaluation Environment to support engineering level assessment/exploration of individual protective clothing, shelter, and nutritional items in high fidelity simulated settings that accurately recreate actual use environments.
Description: During the envisioned effort an end-to-end virtual evaluation environment will be created that supports exploration of proposed new, changed, or enhanced individual clothing and equipment, food, shelters, and ground mobility items. In this environment the available fidelity will support: 1) examination of the effects resulting from small changes in item characteristics; 2) rapid execution of numerous simulation iterations for each set of variable pairings to establish statistical significance of proposed changes; 3) parametric analysis of potential item characteristic changes; and 4) examination of the relationship between item characteristic changes and changes in human behavior, performance, quality of life, and survivability.

OSD98-007
Title: Polymer Electrolyte Batteries
Technology: Polymer Science, Electrochemistry
Objective: To develop rechargeable polymer batteries with high specific energies and specific power, based on polymer electrolytes synthesized by enzyme catalyzed reactions.
Description: Future rechargeable batteries for the individual soldier require high specific energies (>150 Wh/kg) and high specific power (>40 W/kg) over a temperature range of -400 C to +700 C. Batteries based on polymer electrolytes have advantages over existing power sources for this application. To meet the above requirements, polymer-based electrolytes require: a) high conductivity at the ambient temperatures, b) good physical and thermal stability, c) chemical compatibility with electrode materials, and d) high recharging efficiency. Conductivity of solvent-free polymer electrolytes presently known are too low at ambient temperatures to be useful. The highest conductivity achieved to date is ~10-5 S/cm at room temperature. Hence, there is a need to develop polymer electrolytes with significantly higher conductivity and stability than the present generation materials, and develop batteries from these polymer electrolytes. It is necessary to pursue unusual approaches in order to develop polymer electrolytes having conductivity of the order of 10-3 S cm- 1. Studies carried out at Natick with enzyme-catalyzed reactions have indicated that tailored polyaromatic compounds may be synthesized with functional groups (such as carboxylic and sulfonic groups) with well defined molecular weight and dispersity. Polymers synthesized from functionalized monomers are expected to have high conductivity, with good thermal, physical and chemical stability.

U.S. Air Force Defense Air Reconnaisance Office (DARO), Advanced Development Division (ADD) /Wright Laboratory
Technology Focus Area: Airborne Remote Sensing
The following SBIR topics support both commercial and military applications for airborne (and spaceborne) remote sensing.

OSD98-008
Title: High Data Rate Solid State Storage of Data
Technology: Airborne Remote Sensing
Objective: The next generation reconnaissance sensors will exceed the capability of current data storage devices. What is needed, is a high data throughput, low bit error rate (BER), digital storage device capable of operating in an airborne environment.

Description: Advancements in military and commercial sensors have resulted in airborne, space, ground and water based systems that collect a tremendous volume of high-resolution imagery. To date, mechanical recording systems have been used to store and disseminate this data. The amount of data to be collected in the future from a single sensor platform, however, is anticipated to exceed the capability of current and projected mechanical storage systems. In addition, mechanical systems are prone to poor reliability and other system errors (hardware/software, communications errors, processing errors, etc.). Fortunately, recent advances in solid state memory modules could meet the anticipated data storage needs. No work, however, is being done in applying these high density solid state memory modules to airborne data storage devices. The offeror should, therefore, address the requirements, development, and demonstration of a solid state memory system capable of meeting the data storage requirements. The proposed system should be capable of storing 500 Gbps - 1,500 Gbps with an I/O of 3 - 10 Gbps with a maximum Bit Error Rate 1E-14. The system shall be highly reliable, maintainable, power consumption less than 100W, and packaged to fit within a volume of less than 1.5 cubic feet.

OSD98-009
Title: Investigate Using Network Protocols on Asymmetric RF Datalinks.
Technology: Airborne Remote Sensing
Objective: To perform computer simulation and modeling of performance of transmitting/receiving ATM cells through an asymmetric Department of Defense airborne RF data link called the Common Data Link.
Description: The DoD Common Data Link is an asymmetric wideband X or Ku-band RF data link used for airborne-to-ground and airborne-to-airborne data applications. The data link may have 10.7, 137, or 274 megabit/s downlink data rates, but only 5 to 200 kilobit/s uplink rates. The DARO is interested in characterizing the performance and effects of using ATM network protocols with an asymmetric data link such as CDL, to transmit and receive MPEG compressed video, still imagery, or other products in an environment where the bit error rate (BER) could range from 10e-3 to 10e-12, with NSA crypto devices and forward error correction in the data link, with or without jamming.

OSD98-010
Title: Phased Array Antennas
Technology: Airborne Remote Sensing
Objective: To investigate feasibility of/performance characteristics for Unmanned Aerial Vehicles, manned aircraft, etc., operating with LEO or HEO satellite constellations for air-SATCOM wideband RF data links.
Description: DARO is interested in operating low (10,000 feet) to high altitude (65,000 feet) airborne systems with low earth orbit, medium earth orbit, or high earth orbit communications satellites to reduce size, weight, power, and aperture requirements on the airborne vehicles vice operating with geo-synchronous orbit satellites. Small aperture, twin-beam, steerable, full duplex conformal phased array antennas are an enabling technology to maintain continuous communications with satellites as they orbit above and disappear over the horizon. The hypothesis is that with a twin beam phased array, the air vehicle could electronically switch from communicating with one satellite to the next without a lapse in communications, and without exceeding size, weight, or power constraints. DARO desires to investigate the feasibility of this technology in the 11 GHz to 40 GHz RF spectrum, operating at 2 megabit/s to 600 megabit/s data rates. DARO specifically desires to investigate the possibility of using this antenna technology with future planned systems.

OSD98-011
Title: Small Size, Multifrequency, Multibeam Phased Array Antenna Systems
Technology: Airborne Remote Sensing
Objective: To determine the technical feasibility of using multi-frequency, multibeam full duplex phased array antennas to allow a ground control station to simultaneously receive and transmit data with up to 2, 3, or 4 airborne systems, such as Unmanned Aerial Vehicles.
Description: DARO is developing or already has in the inventory, systems using C, X, or Ku-band RF data links. Each flying system has an associated unique ground station. DARO desires to investigate the possibility of using a single ground station transmitter to simultaneously send to and receive from multiple airborne systems to reduce ground station footprint, uniqueness, and the requirement for a one-to-one correlation between the airborne system and ground system. Data rates vary from 1.544 megabits/s to 274 megabits/s downlink rates, 64 kilobits/s to 10.7 megabits/s uplink rates. Small physical size suitable for tactical use is desired.

OSD98-012
Title: Advanced Compact Antenna Technology
Technology: Airborne Remote Sensing
Objective: To demonstrate enhanced antenna element gain for small lightweight synthesized virtual antennas to achieve greater performance than the physical antenna element would allow. The goal is to achieve improved signal-to-noise performance in weak and/or adjacent/co-channel interference environments with very compact antennas.
Description: Develop a mathematical model to support the improved performance of a multi-element synthesized virtual antenna. Develop a single prototype element and a prototype synthesized virtual antenna system. Demonstrate the synthesized virtual antenna capabilities for a small lightweight airborne antenna application.

OSD98-013
Title: Object-Level Change Detection
Technology: Airborne Remote Sensing
Objective: To demonstrate processing techniques to determine changes in the presence or position of objects in a scene, while ignoring changes in local or overall scene illumination.
Description: Simple change detection algorithms for imagery may operate by detecting changes in illumination of images. These techniques suffer from false alarms due to differences in illumination conditions between the two frames being compared. Object-level change detection algorithms are based on the ability of the processing to segment an image into areas corresponding to distinct objects. Changes in the status of objects are then detected, due to movement of objects into or out of a scene or within the scene. In addition to the benefits of increased false-alarm immunity, object-level change detection allows a degree of machine understanding of the changes. For example, disappearance of an object in one location and appearance of a similar object in a new location could indicate object movement.

OSD98-014
Title: Optimized Data Compression for Hyperspectral Imaging
Technology: Airborne Remote Sensing
Objective: To develop a lossless compression algorithm that utilizes redundant information both spatially and spectrally.
Description: Hyperspectral imagers can now be procured that are both reliable and fairly inexpensive. This technology availability is fostering a revolution in the military and commercial remote sensing community. The biggest hurdle, however, is the

volume of data obtained with one of these instruments. Recording or downlinking the raw data is often prohibitively expensive. For many applications, degrading the data by applying a lossy compression, invalidates the results. The desired algorithm should determine the maximum lossless compression possible given the spectral/spatial hypercube and efficiently compress the data. If an asymmetric encoding/decoding scheme is utilized, it would be preferable to have the majority of the computation in the encoding.

OSD98-015
Title: Flexible Hyperspectral Dispersive Elements
Technology: Airborne Remote Sensing
Objective: To develop a flexible bandwidth spectral dispersive element.
Description: Exploitation of hyperspectral imagery is currently hampered by the volume of data collected. Current methods detect entire spectrum. However, only certain regions of the spectral information are needed. In fact, most schemes need narrow bands in some regions and only coarse resolution in others. This proposal is to enable the technology for producing low cost custom-design spectral dispersive elements with flexible band centers and bandwidths.

OSD98-016
Title: Optical Field Flatteners for IR Hyperspectral Sensors
Technology: Airborne Remote Sensing
Objective: To produce a high-quality, low cost field flattener for infrared hyperspectral sensors.
Description: The dispersion elements for hyperspectral sensors separate the spectrum in angle. Focal planes, however, are 2-D detectors with pixels of constant dimensions. These attributes force a trade between preserving spectral bandwidth constancy and having a wide field-of-view (FOV) system. Conventional glass field flatteners cannot accommodate the larger field curvatures. This effort will concentrate on using IR optical fibers to provide the necessary field flatness.

U.S. Navy Theater Air Defense PEO - Naval Surface Warfare Center, Dahlgren Division
Technology Focus Area: Modeling and Simulation
The following topics support the commercialization of advanced systems of systems modeling and simulation methods and tools for both DoD and the private sector.

OSD98-017
Title: Information Flow Analysis Capability
Technology: Modeling and Simulation
Objective: To develop information flow analysis capability to define, chart, analyze, and visualize the information elements flowing among a set of objects (platforms, systems, human decision makers) in a complex-adaptive theater warfare system.
Description: A military theater of operation is a complex, dynamic, system of interacting objects constantly adapting to changes in the theater environment. These adaptations are based on the various objects in the theater system acquiring information about the environment, identifying patterns in that information, defining action models based on those patterns, and making decisions to act in some manner on the basis of those models. This process occurs with the human decision makers throughout a chain of command as well as the systems those decision makers use to support their actions. Understanding the information flow and the interactions of information elements within this complex and ever-changing environment is critical to being able to conceptualize and design theater systems and processes.

OSD98-018
Title: Visualization of the Effects of Architectural Failure for Large-Scale High Assurance Systems
Technology: Modeling and Simulation
Objective: To provide engineers with tools which will aid the early understanding of how large, complex systems can fail.
Description: It has been known for years that the earlier that errors in requirements (also design and implementation) are discovered, the less costly they are to fix. By integrating failure analysis tools with modeling and simulation tools which provide for visualization of behavior, the goal of early recognition of requirements and design errors can be realized. The result of this effort will help fully integrate failure analysis into the system development process, thus aiding the understanding of the behavior of large, complex systems when subsystems fail.

OSD98-019
Title: Human Engineering Tools for Engineering of Complex Systems
Technology: Modeling and Simulation
Objective: To develop an integrated set of performance prediction, performance evaluation, workload assessment, and decision support tools for assessing the human engineering aspects of U.S. Navy and commercial system designs within a "systems engineering" (SE) framework. This tool set will be used to evaluate reduced manning and automation concepts for new and evolving large-scale designs.
Description: The Navy needs tools to plan for, design, and evaluate alternative manning and automation concepts (with the goal of reducing crew sizes) prior to implementing specific technologies and designs. While there are a number of tools currently available that can provide designers and analysts with assistance in evaluating these issues, the currently available tools fall short in several key areas. 1) Available tools are not specifically applicable to human system integration issues associated with shipboard manning and the unique team requirements and associated workload issues. 2) Those tools that do exist are designed more for post-design analysis, versus engineering the human operator into the design at the outset. 3) Human engineering considerations of the operator as an integral "system" component are not yet supported in any systems engineering tool sets. An integrated tool set that can perform some set of the following functions will greatly augment current system modeling and analysis capability: a) capture and articulate engineering requirements specific to the human operator, b) weigh the costs and benefits of human operators against automation, c) create candidate display concepts (based upon human factors principles), d) provide performance modeling, and e) perform individual and team workload analyses (including cognitive, perceptual, and motor workload). This integrated tool set must be compatible with existing databases of shipboard tasks and performance elements. Additionally, it must be capable of interacting with typical system engineering models. This set of analytical tools for evaluating automation alternatives in quantitative, unambiguous terms would predict which alternatives would be most likely to result in successfully reducing manning within the domain of safe and effective shipboard operations. These tools are needed to address the allocation of functions and tasks to humans and to advanced technologies, evaluate the design of workstations, interfaces, jobs and procedures, as well as identify additional training requirements resulting from the introduction of new technologies.

OSD98-020
Title: Virtual Prototyping Environments for the Development of Systems of Systems.
Technology: Modeling and Simulation
Objective: To develop an integrated engineering environment which provides new capabilities to enable the prediction and evaluation of total system performance as well

as system design trade-offs. Apply modeling and simulations, synthetic environment, and virtual reality technology to the implementation of virtual prototyping capabilities for the design, manufacture and test of systems of systems.
Description: Virtual Reality (VR) technology is advancing and maturing very quickly. VR technology is now being invested in and applied in many fields such as engineering, manufacturing, chemistry, aerospace, and medicine. The two greatest benefits of this technology have been significant reduction of cost and development time in these engineering disciplines. However, VR has not been substantially utilized in the area of system engineering. Because system engineering deals with large, complex, real-time systems of systems, the greatest benefits are in cost reduction in the system development process. This effort will develop and apply VR technology in concert with system modeling and analysis tools for application to integrated system engineering environments to enable virtual prototyping, virtual manufacturing, and virtual testing of candidate large-scale system designs. The following capabilities are critical in supporting virtual engineering environments: a) generic infrastructure and system engineering life-cycle support for large scale real-time systems; b) distributed simulation support for integrated battlespace engineering and analysis; c) resource optimization for large scale information systems; d) wide area collaborative system engineering; and e) configuration management for distributed large, complex, real-time federated systems architectures.

Naval Air Warfare Center, Patuxent River
Technology Focus Area: Health Monitoring of Navy Aircraft
The following topics will be considered for award:

OSD98-021
Title: Distributed Crack Initiation and Growth Monitoring System
Objective: To develop a Distributed Acoustic Emissions (AE) monitoring system for the detection of cracks in metallic structural components using advanced sensor techniques such as fiber optic sensors. The main requirements of this system is that all the sensors will be powered and interrogated with a single line such as a single optical fiber or a single coaxial cable. The system will be sensitive to frequencies in the 100KHz to 1 MHz band and it will detect the AE events in the presence of quasi-static loading. The loading state will also be determined using the same sensor system.
Description: A system for reliably detecting cracks in aging aircraft structures and in next generation fighters is critically needed. AE monitoring is the only proven method of detecting cracks in metals without having to place the sensor directly in top of the cracks. However, present AE monitoring systems suffer from various limitations. Each sensor needs two wire leads to pick up the signal, the wire leads have to be heavily shielded to avoid EMI, each sensor needs a pre-amplifier and signal conditioner nearby; two more wire leads are required for each amplifier. Techniques that use fiber optic Bragg gratings offer the opportunity of solving all these limitations. A single optical fiber will have embedded in it various Bragg grating sensors, all sensors will be interrogated using a single laser beam, and since there is no attenuation in the fiber there will be no need for pre-amplifiers or signal conditioners. Also, the system does not require EMI shielding since it is optical in nature.

OSD98-022
Title: Distributed Corrosion Monitoring System
Objective: To develop a distributed Corrosion Monitoring system capable of detecting the occurrence of corrosion in key structural components and monitoring its evolution and severity.
Description: It is well known that stress-corrosion cracking and corrosion fatigue can significantly reduce the life expectancy of structures. Therefore, it is critical to develop

a monitoring system which can reliably and accurately detect the amount of corrosion experienced by a structure. In this way early and economic repairs can be performed to the structure at the same time that the useful life of the structure is extended. System concepts should be capable of detecting and monitoring the evolution of corrosion in hidden aircraft structural components such as inside lap joints, around fasteners and under aircraft skins.

OSD98-023
Title: Distributed Adhesive Bond Monitoring System
Objective: To develop a distributed health monitoring system capable of monitoring the integrity of adhesively bonded structures.
Description: The cost associated with periodic inspection of aircraft structures is astronomical. This cost will continue to rise as our fleet ages further with no new replacements for the short term. A health monitoring system could significantly reduce the cost of ownership by reducing or eliminating periodic inspections and replacing them with on demand inspections. Also the reliability of detection would be increased because the damage location could be triangulated beforehand. The inspection time would be reduced because only the damaged site would be inspected and repaired.

OSD98-024
Title: Health Monitoring of Rotating Engine Parts
Objective: To develop a distributed health monitoring system capable of monitoring the integrity of moving engine parts. The sensor system will be permanently installed in the engine and will have to be compatible with the engine environment.
Description: The cost associated with periodic inspection of aircraft engines is astronomical. This cost will continue to rise as our fleet ages further with no new replacements for the short term. A health monitoring system could significantly reduce the cost of ownership by reducing or eliminating periodic inspections and replacing them with on demand inspections. Also the reliability of detection would be increased because the damage location could be triangulated beforehand. The inspection time would be reduced because only the damaged site would be inspected and repaired.

United States Special Operations Command (USSOCOM) Topics
Technology Focus Areas: Special Operations Biomedical; Sensors & Information Technology; and Materials Technology.

Technology Focus Area: Biomedical
OSD98-025
Title: Casualty Retrieval Device
Objective: To develop a casualty retrieval device for safer retrieval and extraction of battlefield casualties.
Description: Casualty retrieval is a high-risk operation, and will be even more so in the future characterized by increased operations in urban terrain. Studies show that 10% of battlefield injuries are received while attempting to render aid to other casualties. The purpose of this effort is to develop a casualty retrieval device for ground forces. The item would allow casualty retrieval from a safe location and distance. One concept could be a munition deployed net. The item should have the following objective characteristics:

a. Single or multiple use (i.e., reusable);

b. Lightweight - Less than 1kg for a single use device. Less than 2 kg for a multi-use device;

c. Capable of engaging and retrieving a casualty and his/her load bearing equipment weighing less than or equal to 120 Kg over a distance of 25 meters. It would be desirable for this device to also work when the casualty is in the water, and for this

device to be capable of lifting the entire weight of the casualty (with gear) vertically (i.e. up walls, ravines, etc.);

d. Reliability, durability, and affordability will be additional considerations.

Technology Focus Area: Sensors & Information Technology

OSD98-026

Title: Electronically Scanned Phased Array Antenna (ESA)

Objective: To develop a low cost and lightweight ESA for rotary wing and tilt-rotor aircraft.

Description: It would be highly desirable for military aircraft to utilize low-power radar when operating in all-weather conditions and low altitudes. The problem with this class of radar is that it requires a large antenna to receive an acceptable return to conduct operations. While such an antenna is acceptable for fixed wing aircraft, it is not for rotary and tilt-rotor aircraft because of on-board size and weight constraints. An antenna that is both small enough to fit aboard rotary and tilt-rotor aircraft, and large enough to facilitate the necessary return is not currently available. Electronically scanned antenna (ESA) technology could provide the solution to this requirement. The intent of this project is to develop a lightweight, low cost ESA that will allow incorporation of low-power coherent type radar systems on-board rotary and tilt-rotor aircraft, and at the same time significantly decrease the support cost for radar systems on-board rotary aircraft.

OSD98-027

Title: Stand-Off Tag Emplacement

Objective: To develop the ability to place tracking devices on objects and individuals remotely.

Description: While tagging and tracking technologies are progressing for both military and commercial purposes, the ability to affix or emplace tags remotely has not been addressed. There is a need for the capability to emplace tagging/tracking devices remotely and clandestinely, which would be useful in secure, hazardous, or denied environments. The purpose of this SBIR effort would be to develop tag emplacement concepts and associated equipment. The optimum emplacement concept will probably limit and might define the tagging/tracking technologies that can be utilized, so a systems level approach to development and testing must be used. A system is desired that can be employed (i.e., emplaced and monitored) to track high value assets inside buildings and outdoors, and in all types of weather and terrain, while allowing operators to remain safe distances away.

Technology Focus Area: Computing and Software

OSD98-028

Title: Database Conversion Software

Objective: To develop a process which converts native format databases to other formats with little or no loss of resolution.

Description: Special Operations Forces use a variety of mission planning and mission rehearsal tools which depend on imagery based or partially imagery based terrain databases to provide a 3D visualization of the environment in which the mission is to be carried out. There are several database generation facilities that provide products. Some facilities are USSOCOM activities. However, there are other facilities that are not controlled by USSOCOM, which provide products in different formats. The conversion of databases from one format to another currently requires separate converters for each format. Our requirement is that industry provide a process, mechanism or other approach, which enables multiple “run time” databases to be developed for a unique platform from a single original source database and that this process be accomplished rapidly with minimal manual interaction and without loss of geo-spatial fidelity. This

will significantly expand the utility of current rehearsal devices. Further, it will enhance the ability to rehearse the time sensitive missions by expanding the terrain available on short notice.

Technology Focus Area: Sensors
OSD98-029
Title: Examination of Emerging Haptic Tactor Technology
Objective: This effort is directed at emerging technologies that are adaptable to providing haptic cues to military personnel operating in various environmental conditions. The objective is to produce tactors with improved characteristics in the following areas: 1) miniaturization, 2) variable tactile sensor strength (frequency and amplitude modulation), 3) robustness (shock and vibration), 4) waterproofing, 5) reliability, 6) produceability, and 7) magnetic signature. A successful development program will include the achievement of the following technical objectives:

a. Demonstration of tactors that provide adequate haptic cues that are, at a minimum, twice as small as existing tactors, exhibit no (goal) electromagnetic signature, are waterproof and operational to depths of 66 fsw and altitudes to 35,000 ft., and at ambient temperatures ranging from 0˚C. to 33˚C.

b. Demonstrate reliability and durability greater than present day tactors.

Description: Tactor research is a one element of a larger program referred to as the Tactile Situation Awareness System (TSAS). The initial objective of the TSAS program was to decrease spatial disorientation accidents in the aviation community. Several studies concluded that human-factors problems accounted for the bulk of aircraft mishaps, and that spatial disorientation was the most significant human-factors problem both in terms of material and personnel losses as well as mission degradation. The 1990 Naval Research Advisory Committee Panel on Aviator Physical Stress concluded that "current displays are not adequate to prevent spatial disorientation mishaps. It is imperative that research and development be focused to ensure introduction of improved displays, controls and decision aids to reduce pilot workload." Subsequent research demonstrated that tactile displays can be an effective method of reducing or eliminating spatial disorientation, as well as providing an alternative method of receiving information from typical visual or auditory displays. This technology is now being applied to enhance navigation, communication, and warning controls and indicators for air, surface, and subsurface Special Operations missions. Another application that is under investigation is the use of tactile technology to stimulate motion sensations in non-motion based training simulators.

The principle of TSAS technology is relatively simple. Inputs provided from a source such as navigation equipment (GPS, Loran, inertial navigation systems, etc.,), gyroscopes, altimeters, accelerometers, communication devices, pressure gauges, alarms, indicators, etc., are processed by a small computer and converted into outputs that control the activation of tactors placed against the skin of an operator. The tactors provide electrical or mechanical stimulus (vibration) that is sensed by the operator. These sensations are cues for operator action. As an example, a diver receives a vibration on the left side of his/her body indicating that they are off-track of a predetermined navigation course. The diver swims in the direction of the vibration (to the left) until the vibration stops indicating they are back on course. The need for a visual display for the diver navigation has been eliminated resulting in less visual and mental workload for the diver.

A TSAS laboratory system has been developed in a collaborative effort between the Naval Aerospace Medical Research Laboratory (NAMRL), Pensacola, FL and the Coastal Systems Station (CSS), Panama City, FL. One of the many purposes of this laboratory system is to develop computer generated graphical simulations so that the feasibility of

applying tactile technology to SOF/DoD operational areas can be evaluated. Simulations of high speed surface craft navigation, underwater mine search, aircraft navigation and maneuvering, and space shuttle docking have been developed and demonstrated. Selected technologies have then been transferred from the laboratory system to operational equipment. In FY 97 TSAS technology was successfully demonstrated by hovering a UH-60 Blackhawk helicopter using tactile cues. During the same year, an underwater navigation device used by Explosive Ordnance Division divers was interfaced with a TSAS to successfully demonstrate enhanced underwater navigation using only tactile cues.

OSD98-030
Title: Small Craft Vision Enhancement/Situation Awareness System
Objective: To develop an all-weather vision enhancement system, or new components for existing systems, to support navigation of small military maritime craft (<36 ft) operating in littoral areas and extreme environments.
Description: Small military maritime craft (<36 ft) are used in low to medium threat. To facilitate all weather operations there is a need for vision enhancement systems to supplement existing navigational aids. The system(s) should integrate and fuse sensors, and processing and display elements to provide situational awareness in all types of weather, daylight, and hours of darkness. Nominal objectives are to detect a 100 ft craft at 3 miles, a 25 ft craft at 1 mile, and a navigation buoy at 1500 ft, regardless of sea-state, weather, and daylight conditions; and without increasing the craft's organic signature. Key limitations are size (less than 12 inches wide by 12 inches by 8 inches total net package size) and weight (less than 20 lbs total net package weight). Challenges include sensor mounting and operation in extreme environments, which include exposure to high g-loads and sustained vibrations, temperature and humidity extremes, and saltwater intrusion. Mounting consideration must be given to utilizing existing attachment points to include weapon mounts and display consoles. Technologies applicable to this effort include sensor fusion and image processing algorithms, high-performance and lightweight FLIR/low-light level camera systems, high performance and low power/signature displays, and stabilizing/shock mitigation packaging and mounting systems.

OSD98-031
Title: Affordable Millimeter Wave (PMMW) Electronic Technology
Objective: To demonstrate through measurement, simulation, and testing, the applicability of new PMMW millimeter wave sensor technology to diversified military aviation mission requirements, with a primary focus on affordability.
Description: The military has an inherent need to develop enabling passive as well as active sensor technology that is both affordable and flexible, with growth potential to address new requirements. Passive millimeter wave sensors are an emerging technology whose development is being facilitated by recent advances in low-noise millimeter wave components. The advantages of such sensors are that they enjoy all weather performance and are not readily detectable. PMMW sensors would inherently lower signature characteristics in an auxiliary sensor mode, and provide threat information while in an active mode. Combined with the low cost potential of evolving components, this technology offers great promise for application on aviation platforms. PMMW is envisioned as a multi-role sensor that could provide affordable all-weather navigation and reconnaissance capability and possibly communications capabilities with minimal demand for weight, space and power.

Technology Focus Area: Materials, Processes, and Structures
OSD98-032
Title: Lightweight, Portable, Blast-Resistant Barriers
Objective: To develop a barrier system, which is light, easily deployable, but made of material rugged enough to thwart a conventional blast sufficiently to protect structures.
Description: Current semi-permanent barrier systems are typically constructed of concrete or stone. These tend to be difficult to move or redeploy. Sandbags, large earth and stone mounds can be used as temporary barriers, but they provide limited protection and are time-consuming and difficult to erect. The Special Operation Force (SOF) is in need of easily deployable deflection-type barriers, which can stop and/or deflect the effects of a blast away from troops in garrison, buildings, and other structures. An "ideal" solution would be a barrier that deflects effects back to the point of origin; i.e., a car bomb explodes and the barrier sends all the debris back toward the blast or straight up in the air, away from the targeted structure. Design consideration must be given to preclude the barrier from being used to aid the explosion. The system should be employable with minimal support and material handling equipment.

U.S. Army Medical Research Acquisition Activity Topics
Technology Focus Area: Biomedical Research
The U.S. Army Medical Research Acquisition Activity has identified the following seven biomedical research topics:

OSD98-033
Title: Decontamination of Nerve Agent Exposed Personnel: Preparation of Towelettes Consisting of Immobilized Enzymes that Destroy Toxins
Objective: To develop a personal decontamination kit to remove and inactivate organophosphorous compounds from skin, wounds, or other sensitive surfaces of exposed soldiers. Such decontamination devices will also protect field medical personnel from cross-contamination and secondary contamination while attending the chemical casualties.
Description: A kit consisting of disposable towelettes similar to 2x4, 4x4, or 4x6 inch surgical pads consisting of a mixture of immobilized enzymes to destroy organophosphorous compounds is needed for personnel protection. The combination of enzymes would be cholinesterases (acetylcholinesterase/butyrylcholinesterase) and organophosphorous hydrolases from bacterial or animal origins which metabolize organophosphates (e.g. paraoxon hydrolase, phosphotriesterase, or squid diisopropylfluorophosphate hydrolase). Enzymes would be covalently linked to a matrix, like polyurethane, to form the correct texture, poracity, and consistency to function as towelettes or sponges. By crosslinking the enzymes to an immobilized support, the towelette would resist leaching of the enzyme to the skin, be stable at a wide range of temperatures, and retain enzymatic activity for a long period of storage. To increase the efficacy of such a device, an oxime would be added in the solution in which the towelette is packaged. This will ensure that the catalytic activity of organophosphate inhibited cholinesterases will be rapidly and continuously regenerated, and that the organophosphate on the skin will be detoxified.

OSD98-034
Title: Development of In Vitro Model System for Screening the Effects of Botulinum Neurotoxin
Objective: To replace the current mouse botulinum toxin neutralization assay, in whole or in part, with in vitro assay systems for determining toxin activity, antibody titers and evaluating candidate medical countermeasures.

Description: The toxin neutralization test in mice used to determine the activity of botulinum neurotoxins and neutralizing antibody in sera is cumbersome and requires a large number of laboratory animals as well as trained technical staff. Reproducibility between laboratories has also been problematic. There have been a number of alternative in vivo assays proposed. Although these may provide enhanced reproducibility and sensitivity in a given laboratory, they still suffer from the same technical constraints of the standard in vivo protocol. Although relatively sensitive Enzyme-Linked Immunosorbent Assays (ELISA) for detection of Clostridium botulinum neurotoxins and solution-phase complexes (antibody) have been developed there is a lack of definitive correlation between ELISA and biological activity of the toxin or neutralizing antibody. Ideally a motoneuron based biological system would be developed that is capable of releasing acetylcholine (Ach). This could be used as an in vitro model system for screening the effects of botulinum neurotoxins, toxin activity, toxin neutralization and candidate medical countermeasures. Similar systems have been developed to evaluate Clostridial neurotoxins and substrate proteolysis in intact neurons. These primary cell cultures do not survive for long and cannot be utilized in the screening assays. To be practical, the cell line would have to be stable for several months in culture, be well characterized, and provide reproducible responses.

OSD98-035
Title: Blood Processor for Hydroxy Ethyl Starch
Objective: To develop a medical device to process the frozen/thawed blood cryoprotectant hydroxy ethyl starch.
Description: Research and design a closed sterile filtration device to automatically thaw and wash out the frozen/thawed blood cryprotectant hydroxy ethyl starch; and add blood preservatives to attain 8 week post thaw storage. The suggested design concept is for a microprocessor-driven tabletop device with heated plates for thawing; and a peristaltic pump and valve system for processing. It should weigh less than 100 pounds, have a footprint less than 2 square feet, and a height less than 3 feet. Other design goals include: processing time less than 10 minutes; direct infusion after 8-week post thaw storage without further processing; maximum 1 liter of a single wash solution; and disposable costs less than $50. Input power should include the following multiple options: 110/220 volts AC 60 Hz; 220 volts 50 Hz (European power); commercial or generator driven tactical sources. The device should be universal and flexible so that it can be adapted for other blood processing procedures.

OSD98-036
Title: Development of Temperature and Humidity Insensitive Dental Materials
Objective: To develop, test, and deploy polymeric based dental materials that are temperature and humidity insensitive for use under deployed conditions.
Description: Current polymeric dental materials, both those used as a portion of a composite restorative system and those used as impression materials, are prone to unpredictable physical properties when used outside controlled environmental conditions. Extremes in temperature and high humidity cause deterioration of most desirable properties. Storage histories of these materials also adversely effect physical properties. Development of temperature and humidity insensitive dental materials would allow much more predictable results in deployed situations. It would also permit relaxed handling and storage of these materials.

OSD98-037
Title: Head Motion Tracking and Performance Measurement of Helicopter Pilots During Simulated Flights Over Digitized Terrain
Objective: To develop and build a PC-based virtual reality projection software and hardware system which can be easily programmed, maintained and operated by the user.

The system will be used in various laboratory settings, including the study of the effects of head-supported devices on the performance of helicopters pilots during simulated terrain fly-over and while exposed to whole-body vibration.
Description: An important function of helmets worn by helicopter pilots is its use as a platform to mount an array of devices that enhance the pilot's performance. The weights of these helmet-mounted devices (HMD) have increased as they became more complex and as new capabilities are introduced. The effects of the added weight on pilot fatigue and performance is evaluated in a laboratory setting prior to final fielding. Because of whole-body vibration and the HMD added weight, the accuracy of tracking a moving target is likely to degrade. With recent proliferation of virtual reality (VR) software and hardware, the accuracy of target tracking can be measured using inexpensive computer platforms and drawing upon public domain terrain data, open architecture graphic software and lightweight tracking hardware. Many components of the desired system have been demonstrated to work in commercial, shareware and freeware video game and research products on inexpensive personal computer platform, i.e., they do not require expensive graphic workstation hardware and software. These include: 3-D motion tracking devices that monitor the head motion; terrain simulation based on published terrain elevation satellite data; interactive terrain fly-over that simulates the view from the cockpit as the pilot maneuvers the helicopter; real-time display of instruments and symbols to reflect pilot's actions; the ability to control and pre-program the mission profile; and monitoring and scoring of pilot's tracking actions. Since the system will be used for evaluation of HMDs, VR goggles and similar head-worn devices cannot be used. Instead, VR imagery must be projected on one or multiple screens as necessary. The desired system is not intended as a training platform but as an inexpensive research tool that can be easily modified and maintained as new technologies or research requirements emerge.

OSD98-038
Title: Development of a Catalytically Reactive Topical Skin Protectant (rTSP) Against Chemical Warfare Agents
Objective: To identify and synthesize catalytically reactive materials capable of neutralizing chemical warfare agents (CWAs), vesicants, and/or nerve agents when incorporated into a cream of perfluorinated polyether oil thickened with polytetrafluoroethylene, that can be applied to the skin as a protectant from cutaneous exposure to CWAs.
Description: There is a requirement to develop catalytic materials capable of neutralizing CWAs that contact the skin. These materials must prevent the toxic effects of skin contact with CWAs when the catalyst is incorporated into a cream of perfluorinated polyether oil thickened with polytetrafluoroethylene. This cream has already been demonstrated to provide a physical barrier against CWAs. The incorporated catalysts must enhance the barrier effect of the cream by chemically neutralizing the CWAs, so that in case of barrier breakdown the agent is no longer toxic. The material should have reasonable cost, be safe and nonirritating, be chemically stable, and demonstrate rapid kinetics. Successful proposals must possess a viable concept, an evaluation plan demonstrating a logical sequence of steps to identify, synthesize and test the catalytic materials for preparation of the final product.

OSD98-039
Title: Detection of Persons with Mild, Intermittent Asthma
Objective: To develop a rapid, inexpensive method to screen all military recruit applicants for asthma, particularly those with mild or moderate disease. Results should be standardized and easily interpretable by physicians without specialty training in pulmonary medicine. The screening test should be sensitive, specific, and without significant health risk to persons tested.

Naval Sea Systems Command Topics
Technology Focus Area: Materials Process Technology Area

OSD98-040
Title: Fire Resistant Organic Composite Material
Objective: To develop a low cost organic composite resin material which meets the fire and toxicity requirements of MIL-STD 2031, possesses mechanical properties similar to standard vinylester and polyester resins, and can be processed using a vacuum-assisted resin transfer molding (VARTM) process and low-temperature cure.
Description: The low cost organic composite resin material should be <$10/lb and be resistant to structural degradation and toxic off-gassing when subjected to a severe fire insult. This resin system must have a viscosity suitable for VARTM fabrication, a cure temperature less than 160˚F, and maintain mechanical properties at operating temperatures of 200˚F.

OSD98-041
Title: Superelastic Shape Memory Alloy (SMA) for Seal Applications
Objective: To develop robust, corrosion free and long life sealing technology utilizing a superelastic shape memory alloy made by either plasma spraying or other near net shape processes.
Description: Recent advances in the plasma spraying of conventional SMA have indicated that this process could be modified to produce superelastic SMA material. This superelastic material could be used to solve the long standing Naval problem of reliably preventing green water and other fluids or air-born contaminates from entering a vessel. Future surface ships will require advanced hatch and hanger door seals. SMA seals would have the advantage of being non-pyrolytic, large strain (more sealing force), tough, non-corrosive and Radar Cross Section (RCS) compliant. Challenges include adapting the processing techniques to produce superelastic material in sufficient lengths and thickness in near net shape.

OSD98-042
Title: Development of a Self-Cleaning Filter System for Navy Shipboard Reverse Osmosis Application
Objective: To develop a small/lightweight self-cleaning filtration system for shipboard Reverse Osmosis (RO) desalination plants to enable operation in port and other areas close to shore.
Description: The Navy is presently developing a RO desalination plant for aircraft carrier application. The major problem foreseen with the operation of such a plant is when the ship is operating in coastal areas and in the open ocean where large quantities of colloidal solids and plankton/small animal matter occasionally exist. High concentrations of colloidal solids and plankton/small animal matter in the seawater feed stream to the RO system have been found to plug and blind strainers and filters on Navy surface ships (such as destroyers), virtually disabling the filtration system from operating. The typical solution to this problem often proposed by commercial vendors is to use large multimedia filters (volumes in excess of 750 cu. ft. and weights above 25,000 lbs.) to remove these foulants from the 300 to 400 gal/min feed seawater stream. Filtration systems of this size and weight are unacceptable for Navy shipboard application. Therefore, a small lightweight self-cleaning/back-flushable filter is sought for shipboard RO application.

OSD98-043
Title: High Temperature Multifunctional Core Material for Lightweight Composite Structures
Objective: To develop structural core material, which can be used with composite material processing as a fire barrier system and can provide multifunctional capability to the composite section.
Description: Composite materials are currently being investigated for use as the structural material for topside structures as well as other Naval applications. Low cost composite processing materials such as glass/vinylester composites are the material of choice. Solid cores (balsa) and foam cores (pvc, urethane, etc.) have been considered. These core materials have high temperature performance limitations. A core material which could maintain structural integrity after the UL 1709 fire testing is the goal for the core material. In addition, incorporation of various signature characteristics is desired, such as Radar Cross Section (RCS) control, electromagnetic interference (EMI) shielding, and frequency selective surfaces for antenna concerns. These characteristics, for example, were incorporated in the Advanced Enclosed Mast/Sensor System (AEM/S). The core material should be compatible with vacuum assisted resin transfer molding (VARTM) type processing and should be environmentally stable in the temperature range of -60 to 180˚F, not be degraded by water and be capable of surviving 30 year service life. Large quantity acquisition costs should be comparable to that of high temperature foam, e.g. pvc foam ($16/board foot).

OSD98-044
Title: Lightning Protection for Ship Topsides Fabricated of Composite Materials
Objective: To develop, demonstrate and document an effective, low signature, low cost, lightning protection system for topsides of ships that are fabricated of non-metallic materials.
Description: The lightning protection system must be capable of providing sufficient protection against lightning strikes in a natural environment as specified in MIL-STD 464.